

SACRED PHILOSOPHY

SEASONS.

SACRED PHILOS[illegible]

OF THE

SEASONS;

ILLUSTRATING

THE PERFECTIONS OF GOD

IN THE

PHENOMENA OF THE YEAR.

BY THE

REV. HENRY DUNCAN, D. D.

RUTHWELL.

WINTER.

"He giveth snow like wool; He scattereth the hoar-frost like ashes; He casteth forth his ice like morsels Who can stand before His cold?"—
PSALMS.

SECOND EDITION.

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There is a philosophy which nobly exercises our reasonable faculties, and is highly serviceable to religion.—Such a study of the works of God as leads us to the knowledge of God, and confirms our faith in Him. But there is a philosophy which is vain and deceitful, which sets up the wisdom of man against the wisdom of God, and, while it pleases men's fancies, hinders their faith."—DAVENANT.

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PREFACE.

Of all the works on Natural Theology, which, in former or recent times, have enlightened and delighted the pious mind, none of any great extent, or of much importance, have been devoted to the illustration of the Divine perfections, in connexion with the Seasons of the Year. Yet this is a view at once interesting and popular. The changes of the seasons display, in themselves, a remarkable and beneficent arrangement; and the adaptations by which vegetable and animal life are fitted to exist, and to fulfil the end of their creation, during these changes, afford ample materials for a beautiful and striking exhibition of the power, wisdom, and goodness of the Creator.

In investigating this subject, we meet every where also, with the most remarkable analogies in the character of the material world, with that which is so distinctly impressed on Revealed Truth; and, while we hence derive a very satisfactory argument in proof of their origin from the same Almighty and Intelligent Author, we find that these kindred sources of information continually throw a light, clear, consistent, and

useful on each other, the latter exalting the former, and raising it to the dignity of a perfect science.

The attention of scientific men, while it has of late been very successfully, has, perhaps, been too exclusively, directed to the book of Nature, in illustration of the Divine perfections; and those, who peruse their writings, may be induced to overlook the highly important truth, that, after all, natural religion affords but an imperfect glimpse into the moral attributes of the Eternal; and that, without the aid of a direct communication from Heaven, a most ominous gloom hangs over these attributes, and sheds mystery, anxiety, and doubt on the future destiny of man.

One great object of the Author, in the following pages, is to counteract this unhappy tendency, and to show that the God of Nature can only be known, in the perfection of his character, when regarded as the God of Grace; and that it is not till the light of Revelation shines on the Divine operations, that the clouds and darkness, which surround the throne of the Most High, are dispersed. Under the illumination of this celestial light, the study of creation is, in the highest degree, calculated to expand the understanding, enlighten the judgment, and improve the heart. If it be true, that the human mind takes its character from the nature of the subjects with which it is conversant, we may assuredly expect that it will be ennobled and refined, when it is humbly, judiciously, and piously occupied in investigating the attributes and works of Him, who is the First, and the Last, the Greatest, and the Best.

The most important and animating views of the Creator and His operations, in reference to the Seasons, are found scattered through many publications, which it has been the agreeable task of the Writer to combine in a new series, and render generally accessible. In doing this, he has frequently quoted the precise words of the various authors from whom he has borrowed his facts. He has no ambition to acquire fame as an original writer; his more humble, but perhaps not less useful aim, being to instruct and edify those who may not be in possession of many works on Natural Theology, by rendering them acquainted with the discoveries, which have been made by others, in the most interesting of all sciences.

The plan adopted by the well-known, but somewhat antiquated, German author, STURM, in his "Reflections," has been so far imitated, that the Work contains a paper for every day of the year, and is thus well suited for stated family reading. The chief reasons which induced STURM to give his Work this form, as he himself observed in the advertisement to the first German edition, were,—"First, to provide a sufficient variety; and, secondly, that the reader might be led to sanctify each day, by contemplating the works of God." These are also the motives of the present Writer; but the desultory manner and declamatory style of this author he has endeavoured to avoid; and a more systematic method has been attempted, replete with facts and illustrations, so as to form a whole, containing, what the title expresses, the "SACRED PHILOSOPHY OF THE SEASONS."

It is customary, in enumerating the Seasons, to commence with *Spring;* and it may be proper, in a few words, to state one or two reasons which induced the Author to depart from that order, and begin with *Winter.*

Winter is not the death of Nature, neither is it merely the season of Nature's sleep after the labours of the vegetable world are finished: It is much more. It is the season of gestation, when Nature is preparing in her womb the embryo of the coming year. A thousand secret operations are in progress, by which the seeds, buds, and roots of future plants and flowers, are not only preserved but elaborated, that, when the prolific months of Spring arrive, they may burst into life in all the freshness and vigour of a new birth. This, which is both a more important and a more interesting view, represents winter as the first stage in the processes and developments of the revolving year, and fixes it as the natural commencement of a Work, which has for its object an exhibition of the SACRED PHILOSOPHY OF THE SEASONS.

There is another circumstance, too, which involves no principle, indeed, like the former, but which renders the plan adopted a matter at least of convenient arrangement. Winter is the season in which, although the hand of a beneficent and wonder-working Creator is every where to be distinctly traced, there are fewer objects of interest, in comparison with the other seasons, to arrest the attention, and to engage the mind in devout contemplation of the Divine perfections. An Author, studying to gain the public fa-

vour, must, doubtless, regard this as a disadvantage in making his first appearance ; but then, it has this counterbalancing use, that space is thus gained for some necessary introductory papers on the broader and more general cosmical arrangements, which are peculiar to none of the seasons, but common to them all. As the plan of *daily* reflections, of a certain moderate length, obliges the Author to stretch his literary offspring, as it were, on Procrustes' bed, the convenience of including such papers in the volume devoted to Winter will be readily acknowledged.

The expressions "contrivance," "ingenuity," "compensation for defects," &c., as applied to the operations of the Eternal, seem, in some sense, to detract from the infinite perfection of His character, and to bring the exercise of His attributes too much on a level with the operations of the human mind. But this arises from a defect, not merely in the language, but the conceptions of men ; and while we are sensible of the inadequacy of these expressions, we know not how to apply a remedy. In this, the Writer only follows in the track of others.

The Sunday papers contain religious and moral reflections, generally suggested by the subject of discussion on the preceding week.

A few papers have been kindly furnished by ingenious friends, which are distinguished from those of the Author, by being subscribed with their initials.

RUTHWELL MANSE,
October 20, 1836.

NOTE TO THE SECOND EDITION OF THIS VOLUME.

A LARGE edition of "Winter" having been disposed of in three months, and a second edition being called for, the Author has felt it his duty, amidst various avocations, to make a revision of the Volume, hasty though it has necessarily been. Some alteration has been made in the arrangement of the papers, which he trusts will be considered an improvement, and he has endeavoured to avail himself of several judicious hints thrown out by the Reviewers, for which, as well as for their other friendly strictures, he feels himself under obligations.

RUTHWELL MANSE,
April 1, 1837.

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SACRED PHILOSOPHY

OF THE

SEASONS.

WINTER.

FIRST WEEK—SUNDAY.

GOODNESS OF GOD TO HIS RATIONAL CREATURES.

We are about to commence a course of study which will lay before us, in detail, abundant proofs of beneficent design, exhibited in the various departments of creation; and we surely cannot better employ this first day of the first week of our delightful and edifying task, than in considering some of the more obvious and general evidences of the paternal regard, which the Creator bestows on our race—the chief of his sublunary works.

But the difficulty lies in knowing where to begin, and what to select; for we cannot turn in any direction where His love does not smile around us. In Him we live, and move, and have our being; and all that we possess flows entirely from the exhaustless source of His bounty. From the first moment of our existence, His guardian arm surrounded us, and at this instant we are the objects of his providential care. He listened to our helpless cries, and supplied all our infant wants, before our hearts had learned to acknowledge their benefactor, or

our tongues to pronounce His name. It was He who opened the bosoms of our parents to impressions of tenderness, and taught them to experience a nameless delight in those little attentions which our tender years required. To secure the good offices of the generous, He clothed our countenances in the smiles of innocence; and, to soften the hearts of the cruel, He caused our eyes to overflow with tears. He strengthened our bodies and enlarged our minds. Through all the slippery paths of youth, His hand unseen conducted us, guarding us from temptation, delivering us from danger, and crowning our days with His goodness. And whatever period of life we have now reached, we owe our continued lives to His preserving care, and our blessings, both past and present, to His paternal bounty.

Let us look at particulars. If we turn to our connexion with surrounding nature, it is God's air which we breathe, and God's sun that enlightens us. The grateful vicissitudes of day and night, the revolutions of the seasons, and regular return of summer and winter, seed-time and harvest, are all appointed by His unerring wisdom. It is His pencil which paints the flower, and His fragrance which it exhales. By His hand the fields are clothed in beauty, and caused to teem with plenty. At His command the mountains rose, the valleys sank, and the plains were stretched out. His seas surround our coasts, and His winds blow, to waft to us the treasures of distant lands, and to extend the intercourse of man with man.

But we are made capable of more exalted enjoyments than can be derived from external nature; and He, who formed us with these capacities, has not left us without the means of exercising them. Originally created in the image of God, the human soul, though apostate, fallen, and degraded, still retains the embers, as it were, of the fire which came down from heaven to animate it; and, as if conscious of its celestial origin, finds permanent enjoyment only in the cultivation of those faculties

which prove its resemblance to its Creator. Nor has the Father of mercies left us without the means of such enjoyment. In society, the pleasures of beneficence and the movements of compassion ; in friendship, the interchange of good offices, and the balm of sympathy ; in domestic life, the tenderness of conjugal affection, and the endearments of filial and parental duty ; and, to crown all, in religion, the sublime enjoyments of devotion, and the blessed hopes of immortality, give an unspeakable charm to existence, and prove the Divine Being who bestowed these gifts, to be full of condescending kindness to his rational offspring.

It is true, however, that we derive a taint from our first parents which blights all these blessings, and that, so long as we remain in our natural state of alienation and rebellion, an unexpiated curse rests upon our heads. But here it is especially that the bounty of the Eternal is displayed. Man, indeed, was expelled from paradise ; and the fair world, of which he had proved himself unworthy, was rendered suitable to his fallen condition. But it was not the will of God that the human race should be abandoned to perish in their misery ; and, while His justice executed the merited sentence, His mercy gave assurance of future deliverance, and

"Hope, the charmer, lingered still behind."

Nothing can be conceived more beneficent or more wonderful than that scheme of Divine grace revealed to us in the Gospel of Christ, by which apparent contradictions are reconciled ; by which a holy God is rendered propitious to the unholy, and a just God becomes "the justifier of the ungodly ;" by which sin is punished, and yet the sinner is not only suffered to escape, but is advanced to a higher grade in the scale of existence, and crowned with eternal blessings! That, for the accomplishment of this most astonishing scheme of mercy, God should send his own Son into the world, "in the likeness of sinful flesh ;" that this uncreated Being, becoming a

creature, should tabernacle on earth, and pass through the various stages of human life, a man of sorrows and acquainted with grief; that he should come to his own, and his own should reject and despise him; nay, more, that sinful men should be permitted to lay their impious hands on the "Lord of Life," and put him to a cruel and ignominious death; and that all these mysterious transactions should be the means of removing the impassable gulph which our sins had placed between heaven and earth, and of opening a new way to the regions of immortal felicity, marked by the track of his bleeding feet,—these are events, the high import and matchless grace of which, angels desire to look into, and the human intellect is too feeble adequately to conceive. When the believer thinks of them, his heart overflows with gratitude; and the deep emotion which they excite, finds no language more suitable for its expression, than the short, but emphatic exclamation of an apostle,—"Thanks be to God for his unspeakable gift!"

FIRST WEEK—MONDAY.

THE CHARACTER IMPRESSED ON NATURE.—COMPENSATION.

Before proceeding to the examination of particulars, with the view of exhibiting the attributes of the great Creator, as manifested in the seasons of the year, it is of importance to discover the nature of the principles which are to form the subject of our investigation; more particularly, as there is certainly something very remarkable in the character impressed on the created objects within the sphere of our observation. Were we to commence the inquiry without the aid of experience, founding our expectations on the abstract theories of perfection which we might form in the closet, we should assuredly meet with difficulties and disappointments at

every step of our progress. We shall in vain seek for proofs of absolute perfection, either in the physical or moral condition of this lower world. It is a scene of perpetual change; of beauty, ending in deformity; of pleasure, succeeded by pain; of success, giving way to disappointment; of life, vigour, and brightness, alternating with gloom, decay, and death; and, if the actions of rational agents be regarded, it is a union of wisdom and folly, nobility and meanness, virtue and vice. Instead of perfection, we have here the very reverse. Where, then, are we to seek for the wisdom and goodness of an All-powerful and intelligent First Cause? Our answer is,—In the general character and tendencies of the system; in the arrangements by which evils are averted or mitigated, and excellence is drawn from the very bosom of apparent defect and worthlessness. We are not to expect absolute, but only relative good; not the absence of evil, but compensations for it; not perfection, but a bias toward it. In regarding the whole system, we seem to behold a piece of vast and amazing mechanism, of which the materials are defective or positively unsound, but the workmanship perfect. The wisdom lies in the admirable execution of a work apparently full of difficulties and obstructions; and the goodness, in the conversion of what would seem to be naturally evils, into agents of virtue and instruments of enjoyment.

This, however, is certainly not the real, but only the apparent state of things. That the power of the Eternal, as well as his intellectual and moral perfections, is infinite, it is on other grounds impossible to doubt: that we cannot perceive these perfections in all their extent manifested in his works, must therefore proceed from a deficiency in the grasp of our minds; but we must treat of them according to our own perceptions, and the evidence of Divine wisdom and goodness which, under the modification we have endeavoured to explain, breaks in upon us from every side, is probably, in some respects, better suited to call forth the wonder, admiration, and

gratitude of such limited creatures as we are, than even if we were to see the hand of the Creator less darkly. The view might be too vast, and the glory too effulgent, for our mortal vision.

An apt illustration of the kind of defect and compensation, which seem to be inherent in the system of our world, may be found by attending to the state of external nature in the present season of the year. That there are disadvantages and privations in winter, under which all animated nature seems to shrink and groan, is undeniable; yet how many abatements, and how much positive enjoyment have we to place in the opposite scale!

It will be my duty to examine these abatements of evil, and these actual blessings, separately, in the course of our inquiry; but let us take one example by way of illustration. In our climate, and in all the regions which verge toward the poles, within certain limits, one of the discomforts of winter, which must occur to every person who thinks on the subject, is the shortness and gloom of the day. The sun rises late, looks down for a few hours with diminished glory on a blasted world, and then goes rapidly away, leaving all nature to the darkness of a tedious night. This is dreadful; yet see how it is rendered a source of pleasure and improvement! If, during the absence of the sun, we look at the starry heavens, what an inexhaustible fund of wonders does astronomy unfold, at once to exalt and to humble the human mind,—to fill us with admiration of the Divine perfections, and to teach us the salutary lesson of our own insignificance. It does not require that we should dive into the mysteries of this science, by means of the telescope, before these sentiments arise. They belong to every age of the world, and to every station in life. There is no expression of devotional feeling to which even "babes and sucklings," as it is emphatically said, more readily respond, than that of the psalmist, "When I consider thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained, what is man, O

Lord, that thou art mindful of him? and the son of man that thou visitest him?" How blank and dismal would be the darkness of a long winter night, were it not cheered and rendered sublime by the splendour of the starry firmament!

Look, again, at the comforts and domestic endearments of a winter evening fire-side. Who, that has experienced these, will allege that winter is inferior to summer, either in its enjoyments or in its means of improvement? When early night has spread its shade over external nature, and labour has ceased in the fields, and the sound of busy feet is more rarely heard along the streets; when the shutters are closed, and the curtains drawn, and the fire blazes in the grate, and the candle stands on the table, shedding artificial day, and an united family, shutting out the world, retire within their own beloved circle, to enjoy the social hours; when the father and mother occupy their wonted chimney corners, and the children, while their hands, perchance, are engaged in some light employment, listen with interest to the instruction of some well-chosen book, or bear their parts in edifying and endearing conversation,—who will not confess that there are advantages in this intercourse, which longer days, and a more genial atmosphere, with all the attractions of vocal woods and flowery meads, can scarcely equal?

Here, then, we have compensation for an acknowledged evil:—we have even more. This evil is converted into means of pleasure and improvement; and such is precisely the character of Creative Wisdom and Goodness, into which we have to inquire. He, who expects to find a higher grade of perfection in those manifestations of nature with which he is surrounded, will assuredly be disappointed.

Yet this is a state of things far from being satisfactory to the inquiring mind; and the question still recurs,—Whence is this seeming contrariety and defect? Why does evil exist at all, under the government of an All-

wise and All-powerful Providence? Again, and above all,—Whence is moral evil? How comes it that ingratitude to a benefactor of infinite perfection, and rebellion against the eternal laws of the great Moral Governor, should exist for a single instant, and should be permitted to brave, as it were, the Majesty of the Eternal?

These are questions too deep for human reason; at the bare statement of which, indeed, human nature stands aghast and confounded. Revelation, however, takes up the important subject, and utters its response. The world came from its Creator an image of his own perfections;—but it has been smitten with a curse. The chief of the Creator's sublunary works,—he for whose abode the earth was prepared, and clothed in beauty, who was made but a little lower than the angels, and bore on his breast the impress of his Maker,—that lord of this nether sphere, received the precious gift of liberty, but abusing it, converted it into the means of his own miserable degradation. His destiny was altered, and the world in which he was for a season to dwell was altered also. To fallen man, the earth was no longer to be a place of rest, but of pilgrimage; from a paradise of enjoyment, it has been converted into a school of discipline. That heavenly blessing which had filled the earth, the sea, and the air, with beauty and happiness, was withdrawn. Darkness and tempest, change and decay, were thenceforth to brood over inanimate nature; want, suffering, and death, were to invade the living creation; and the guilty author of this universal blight was himself to be blighted more than all!

But why? Not that this intelligent creature should exist a few unhappy years in a stricken world, and then perish for ever; but that, under the chastisement of a father's rod, he might learn wisdom; and, becoming the object of Divine mercy, might, by means of labours not his own, aspire to honours greater than those he had forfeited, and be made an heir of immortality in a higher and brighter world.

FIRST WEEK—TUESDAY.

THE CHARACTER IMPRESSED ON NATURE.—CONTRIVANCE.

From the example stated yesterday, some idea may be formed of the kind of compensation for permitted evils which is every where to be discovered in the works of creation; but another, and equally marked feature in the face of nature, is that of the most ingenious contrivances, to avoid evils which would otherwise occur, or to insure advantages which could not otherwise be obtained. An example or two of this unequivocal proof of a wise and beneficent Designer will illustrate this subject.

For these I shall take advantage of the ingenious Treatise of Sir Charles Bell on the Human Hand, which is, throughout, a most masterly exposition of the argument, arising from this very view. The first which I select is taken from his chapter on the "Sensibility of the Surface, compared with the deeper parts." That the skin is extremely sensible to pain, no one need be informed; but few, perhaps, have sufficiently attended to the fact, which is yet within the reach of any person's observation, that the pain does not increase in proportion to the depth of the wound, the sensibility being almost exclusively confined to the outward covering of the body. This has been very convincingly proved to be a contrivance of much wisdom and benevolence. After stating the fact, and showing it to be a matter of daily surgical experience, the author justly observes, that the obvious intention is, that the skin should be a safeguard to the delicate textures which are contained within, by forcing us to avoid injuries; and that it does afford us a more effectual defence than if our bodies were covered with the hide of a rhinoceros.

"In pursuing the inquiry," says he, "we learn with much interest, that when the bones, joints, and all the

membranes and ligaments which cover them are exposed, they may be cut, pricked, or even burned, without the patient or the animal suffering the slightest pain. These facts must appear to be conclusive; for who, witnessing these instances of insensibility, would not conclude that the parts were devoid of sensation; but when we take the true philosophical, and, I may say, religious view of the subject, and consider that pain is not an evil, but given for benevolent purposes, and for some important object, we should be unwilling to terminate the investigation here.

"In the first place, we must perceive, that, if a sensibility similar to that of the skin had been given to these internal parts, it must have remained unexercised. Had they been made sensible to pricking and burning, they would have possessed a quality which would never have been useful, since no such injuries can reach them, or never without warning being received through the sensibility of the skin.

"But, further, if we find that sensibility to pain is a benevolent provision, and is bestowed for the purpose of warning us to avoid such violence as would affect the functions or uses of the parts, we may yet inquire, whether any injury can reach these internal parts, without the sensibility of the skin being excited. Now, of this there can be no doubt, for they are subject to sprain, and rupture, and shocks, without the skin being implicated in the accident. If we have been correct in our inference, there should be a provision to guide us in the safe exercise of the limbs; and, notwithstanding what has been apparently demonstrated of the insensibility of these internal parts, they must possess an appropriate sensibility, or it would imply an imperfection. With these reflections we recur to experiment, and we find that the parts which are insensible to pricking, cutting, and burning, are actually sensible to concussion, to stretching, or laceration.

"How consistent, then, and beautiful is the distribu-

tion of this quality of life! The sensibility of pain varies with the function of the part. The skin is endowed with sensibility to every possible injurious impression which may be made upon it; but had this kind and degree of sensibility been made universal, we should have been racked with pain in the common motions of the body: the mere weight of one part on another, or the motion of the joint, would have been attended with that degree of suffering which we experience in using or walking upon an inflamed limb.

"But, on the other hand, had the deeper parts possessed no sensibility, we should have had no guide in our exertions. They *have* a sensibility limited to the kind of injury which it is possible may reach them, and which teaches us what we can do with impunity. If we leap from too great a height, or carry too great a burden, or attempt to interrupt a body whose impetus is too great for us, we are warned of the danger as effectually by this internal sensibility, as we are of the approach of a sharp point, or a hot iron to the skin."*

To this striking pathological argument for benevolent contrivance, might be added proofs without end, from the principles of mechanics. The whole animal frame, indeed, is a piece of the most exquisite mechanism, and the studies of the anatomist abound with demonstrations of the most satisfactory kind. Not only do we find every joint, bone, and sinew, of every species of animal, so adapted to all the rest, and to the nature of its food and habits, as to constitute a perfect system, considered in itself, but when one species of living creatures is compared with others, new kinds of relations and adaptations are discovered, which greatly extend our views of creative contrivance, and increase our admiration. Sir Charles Bell, in the work from which we have quoted, has followed out this inquiry, as respects the human hand, in a very interesting manner; and we cannot better close this paper than by extracting a few sentences from a

* Bell's Bridgewater Treatise, pp. 155-157.

passage where he opens up the principle on which he so successfully expatiates.

"Were I to indulge in the admiration naturally arising out of this subject, and point out the strength and freedom of motion in the upper extremity at the ball and socket joint of the shoulder,—the firmness of the articulation of the elbow, and yet how admirably it is suited to the co-operation of the hands—the fineness of the motion of the hand itself, divided among the joints of twenty-nine bones, it might be objected to with some show of reason, and it might be said,—The bones and the forms of the joints which you are admiring, are so far from being peculiarly suited to the hand of man, that they may be found in any vertebrated animal. But this would not abate our admiration; it would only induce us to take a more comprehensive view of nature, and remind us that our error was in looking at a part only, instead of embracing the whole system; where, by slight changes, and gradations hardly perceptible, the same bones are adjusted to every condition of animal existence.

"We recognise the bones which form the upper extremity of man, in the fin of a whale, in the paddle of the turtle, in the wing of the bird. We see the same bones, perfectly suited to their purpose, in the paw of the lion or the bear, and equally fitted for motion in the hoof of the horse, or in the foot of the camel, or adjusted for climbing or digging, in the long-clawed feet of the sloth or bear [beaver?]. * * * * *

"The wonder still is, that, whether we examine this system in man, or in any of the inferior species of animals, nothing can be more curiously adjusted or appropriated; and we should be inclined to say, whatever instance occupied our thoughts for the time, that to this particular object the system had been framed."*

* Bell's Bridgewater Treatise, pp. 20-22.

FIRST WEEK—WEDNESDAY.

GLOBULAR FIGURE OF THE EARTH.

The character which, in the two preceding papers, we stated as belonging to the works of God, consisting as it does, not in absolute perfection, but rather in contrivances and compensations to abate imperfection, runs through every thing in nature, and may be equally traced in the moral and physical worlds. It may be useful and interesting to examine this character in some of the great arrangements of external nature.

That the universe should be governed by general laws, impressed on matter, is a providential arrangement, the consummate wisdom of which it requires no effort of reasoning to demonstrate; and that these laws should be fixed and undeviating, is a necessary consequence of their existence; for, were they to yield to circumstances, they would cease to possess the character of principles, on the results of which it would be possible either to reason or to act,—that is, they would cease to be general laws. Now, one of these general laws, as simple in its nature, as it is universal in its operations, and amazing in its effects, is the principle of gravitation, of which it has been beautifully said,—

"The very law which moulds a tear,
And makes it trickle from its source,
That law preserves the earth a sphere,
And guides the planets in their course."*

The globular figure of the earth, which is the result of this law, and which may easily be shown to possess many important advantages, presents this formidable difficulty,—that the rays of the sun, issuing in parallel lines from that luminary, must fall directly upon that

* Rogers.

part of the terrestrial ball which is immediately opposed to them, and obliquely, and therefore less powerfully, upon all other parts of its convex surface, till, at the extremes of the hemisphere, they would entirely cease to reach the earth. Were the earth stationary, therefore, the consequence of its globular form would be, that the sun would shine intensely and constantly on a single spot, while one-half of its surface would be left in total darkness, and the other would be illuminated with greater or less force, according to its distance from the sun's direct rays. The disadvantages of such an arrangement need no comment. Now, one way in which this evil is abated, is by what is called the *diurnal rotation of the earth* Our globe is made to whirl round as on two pivots, which are called the poles* of the earth, once in twenty-four hours. This, while it causes the grateful alternation of day and night, conveys light and heat round the world, so as to diffuse them with nearly equal force on every spot within the same parallel of latitude. Were the earth in the form of a cylinder or roller, this rotatory motion would cause the sun to shine equally on every part of its *round* surface, while his rays would never reach the wide flat regions at either end; the days and nights would then be invariably of the same length; there would be no change of climate, and all the habitable parts of the earth would be one burning tropical region, without abatement and without variety. If, on the other hand, the earth, in its present form of a ball, were to have no yearly as well as daily motion, or, having an yearly motion, were to move round its own axis in what may be considered the most simple manner, that is, in an erect position with reference to the sun, the effect would be, that he would constantly shine with his direct rays only on that single line of the earth's surface which is called the equator. There would still be no

* The extended line through the centre of the globe, on which it turns, is called the axis of the earth,—taking the metaphor from the axis of a carriage.

change of seasons, and the accumulated heat in the equatorial regions would be so excessive, as to destroy, in all probability, both animal and vegetable life; while, in the neighbourhood of the polar circle, and even in a vast extent of those countries to which we now give the name of temperate, the globe would be uninhabitable, from the contrary cause of extreme and uniform cold.

The contrivance, by which this inconvenience is, to a desirable extent, removed, is well known. The earth, which, in common with the other planets, performs an annual revolution round the sun, is made to take this course, not in an erect, but in an inclined position; by which means the pole, which leant toward the sun in one part of the course, leans away from it in another. The consequence of this is, that the sun, instead of shining constantly with his direct rays upon the equator, appears to be continually traversing a considerable space in the heavens, shifting from tropic to tropic, and presenting himself for one half of the year to the north, and for the other half to the south of the equator. The various parts of the earth's surface, within the tropics, are thus exposed alternately to the direct and indirect rays of the sun at different periods, and the position and influence of this source of light and heat, is also varied over the whole globe, or, in common language, the diversified appearances of the seasons are produced.

This is a most beneficial arrangement; but it is evident that it could only be salutary within a certain range, for this simple reason, that, were the sun to traverse from pole to pole, it would necessarily happen, that while he was shining vertically on the south pole, the north would be left to total darkness, and the tenfold rigours of a polar winter; and, *vice versa*, while he was pouring the unmitigated radiance of his burning rays on the regions of the north, the south would be doomed to undergo the extreme, which, a few months before, had carried desolation to the north. The fatal consequences of this need not be described as the whole

balance of nature, at present so nicely adjusted, would be upset, the elements would be in constant and furious commotion, and no organized existence, such, at least, as is at present to be found on the earth, could survive the conflict; or, if it did, could endure the violent changes of the seasons, for a single year.

It would be by no means difficult to prove, that the extent to which the range of the sun is actually confined, is precisely that which manifests the most consummate intelligence in the great Artificer. Had it been either more or less than we actually find it, the same advantages would not have been secured, other things remaining as they are, nor would inconveniences have been so effectually avoided. Evils, indeed, still remain; it is part of the system of a world of discipline that it should be so,—but the proof of Divine contrivance lies in this, that these evils are at the *minimum*, while the advantages, on the contrary, are at the *maximum;* that is to say, that any alteration either way would be for the worse. Here, then, we have, what we are taught to look for by the general analogy of nature,—a proof of supreme wisdom in the adjustment of materials—the adaptation of means with admirable skill to a beneficent end.

FIRST WEEK—THURSDAY.

CIRCULATION IN THE ATMOSPHERE AND OCEAN.

We have mentioned the inclination of the earth's axis to the plane of its annual orbit, as the cause of the variety of seasons on its surface; but there are other beneficial arrangements which concur with, and are influenced by this, and without which it would but imperfectly secure what is obviously the main design of the Creator, namely, the furnishing of an extensive and varied sur-

face, fit for the habitation of living creatures, and especially of man, the only creature endowed with the higher attributes of reason, and therefore a subject of moral discipline. Among these arrangements we shall, in the present paper, only allude to the circulation established in the fluid elements which surround our globe.

The expansion of fluid substances by heat, and their contraction, within certain bounds, by cold, is a universal law of nature. Now, this law has an obvious tendency to create circulation. The fluid becoming lighter by being expanded, and heavier when contracted, rises toward the surface, or falls toward the bottom, in proportion to the partial application of heat or cold, and thus tends to diffuse an equable temperature through the whole mass. But this principle has also another effect, which we have more immediately in view. When the fluid expands, it occupies a greater space, and must therefore displace some of the mass with which it is surrounded; when it is contracted, the contrary effect follows,—its diminished bulk is supplied by the rushing in of the contiguous fluid. In either case a current is created.

In regarding the effects thus produced on the atmosphere, it is scarcely possible not to recognise the impress of wisdom and goodness. It is to this cause, operating on the combined air and vapour, that we owe alternate clouds and sunshine, winds and calms, drought, moisture, and rain,—every thing, in short, that we call weather,—the changes of which are so essential to the fertility of the earth and salubrity of the climate. But, in the midst of these alternations, there is another and more extensive operation constantly going on. The atmosphere, heated and expanded at the equator, is continually flowing in the upper regions toward the poles, where, being cooled and contracted, it acquires a retrograde motion, and flows back in a perpetual current toward the equator. This, at least, is its general bias, happily modified, however, by various circumstances and disturbing forces,

which retard, divert, and mingle the opposing currents; and while they reduce the temperature of the one, increase that of the other. This, then, is one of those providential contrivances by which the fervid heat of the torrid zone is alleviated, and the excessive rigour of the polar regions is subdued, while the intervening temperate climates are rendered more salubrious, and the wide extent of earth is prepared for the comfortable sustenance of animal life.

A similar effect is produced by the movements of the ocean. The expanded waters of the equatorial circle rush toward the poles, carrying with them some of the warmth of those burning regions, which they perpetually pour into the atmosphere of the temperate and frigid divisions of the earth; while the chilled and contracted waters of the extreme north and south, throw back their currents upon the tropics, and thus, in their turn, modify the temperature in these latter climates. In our own quarter of the globe, we observe this effect exemplified in what is called the Gulf-stream of the Atlantic, which is a perpetual current, occasioned partly by the law already alluded to, and partly by the form of the African and American coasts, running from the northern shore of South America, where the heat is at its *maximum*, along the coast of the United States, sweeping across from Newfoundland to the Icy Sea, enveloping the British islands, and thence returning along the shores of France, Spain, and Africa, till it completes its circuit by again reaching the southern continent of America and the Western Indies. That the effect which might be anticipated from this circulation is actually produced, we have a proof in the comparative mildness of the temperature in insular countries. The climate of Great Britain, for example, is more equable than that of the adjoining continent, being considerably cooler in summer, and warmer in winter.

"Great as the difference of temperature is in different climates," says Whewell, "it would be still greater if

there were not this equalizing and moderating power exerted constantly over the whole surface. Without this influence, it is probable that the two polar portions of the earth, which are locked in perpetual snow and ice, and almost destitute of life, would be much increased."*

It thus appears, that there is a constant circulation going on in the two great fluids of air and water, analogous in some degree to that of blood through the living body, and productive of the most beneficial effects. The manner in which these are attempered and combined is truly wonderful, and has been the subject of philosophical investigation. In regard to the air, Mr Whewell has shown in what manner its composition and laws are adjusted, so as to correspond with, or to counteract and regulate, the different and sometimes antagonist laws of the vapour, which constantly circulates through it, so as to produce the most salutary effects. This is a question on which I cannot fully enter; but a few observations on the subject of weather, with which it is connected, will occupy our attention to-morrow.

FIRST WEEK—FRIDAY.

THE ATMOSPHERE.

From the expansive power of the atmosphere, and the irregular distribution of heat and cold, combined with the inequalities on the earth's surface, arise those storms and tempests which form one of the most forbidding features in the aspect of winter. This may be regarded as an evil; and it is not to be denied that such elementary commotions are sometimes attended with very disastrous consequences. When the tremendous powers of nature

* Whewell's Bridgewater Treatise, p. 82.

are in motion, indeed, we might well tremble and despair, did we not know that they are under the guidance of infinite perfection. In rare instances, at long intervals, and in limited spots, we are permitted to witness proofs of the desolation which the uncontrolled elements might produce, that by the contrast we may be more deeply affected with a sense of the paternal care under which we daily live. We have heard of hurricanes and tornadoes sweeping whole districts with the besom of destruction,—of the sirocco and simoom carrying instant death on their poisoned wings,—of mountain torrents and swelling seas bursting their ancient boundaries, and bearing wide desolation in their raging waters,—of thunder rending the heavens, and bolts of fire sweeping the earth,—of earthquakes swallowing up whole cities, or volcanoes overwhelming them with floods of lava. But these are only the unfrequent exceptions to a general rule, which has order and happiness for its object, teaching us at once a lesson of humility and gratitude.

If we turn from this view of what might be the universal state of nature, to real events as they occur under our own eye, and are the subject of daily experience, we shall have abundant cause to acknowledge the presence of an overruling hand. How seldom do we actually observe any extensive desolation produced by a winter storm. "All the changes of the weather," says the judicious Whewell, "even the most violent tempests and torrents of rain, may be considered as oscillations about the mean or average condition belonging to each place. All these oscillations are limited and transient; the storm spends its fury, the inundation passes of, the sky clears, the calmer course of nature succeeds. In the forces which produce this derangement, there is a provision for making it short and moderate. The oscillation stops of itself, like the rolling of a ship when no longer impelled by the wind. Now, why should this be so? Why should the oscillations produced by the conflict of so many laws, seemingly quite unconnected with each

other, be of this converging and subsiding character? Is it a matter of mechanical necessity, that disturbance must end in the restoration of the medium condition? By no means. There may be an utter subversion of the equilibrium. The ship may roll too far, and may capsize. The oscillations may go on, becoming larger and larger, till all trace of the original condition is lost; till new forces of inequality and disturbance are brought into play; and disorder and irregularity may succeed, without apparent limit or check in its own nature, like the spread of a conflagration in a city. This is a possibility in any combination of mechanical forces. Why does it not happen in the one before us? By what good fortune are the powers of heat, of water, of steam, of air, the effects of the earth's annual and diurnal motions, and probably other causes, so adjusted, that through all their struggles, the elemental world goes on, upon the whole, so quietly and steadily? Why is the whole fabric of the weather never utterly deranged, its balance lost irrecoverably?"*

The complicated nature of the elements, which enter into the constitution of the atmosphere, renders it difficult, perhaps impossible, to give a distinct answer to these interesting questions, by pointing to the precise law which regulates and controls these elements. Mr Whewell refers to the very peculiar adjustments which were requisite, and are actually discoverable, in the comparatively simple problem of the solar system, by which its motions have their cycles, and its perturbations their limits and period; and, from this analogy, he conjectures, with much probability, that could the investigation be followed out, it would land us in a similar result. However this may be, it cannot but be regarded as a mark of the interference of an intelligent and beneficent mind, that the intensity of those tremendous forces which are employed in our atmosphere should be so adjusted, as not only to preserve the permanence of the

* Whewell's Bridgewater Treatise, p. 107.

system, but also to be adapted to the existence and comfort of the animal creation.

In adverting to the general properties of that wonderful fluid which envelopes our globe as with a mantle, the amiable philosopher from whom we have already quoted, has some beautiful observations, with which we shall close this paper.

"If the atmosphere be considered as a vast machine, it is difficult to form any just conception of the profound skill and comprehensiveness of design which it displays. It diffuses and tempers the heat of different climates; for this purpose it performs a circulation occupying the whole range from the pole to the equator; and, while it is doing this, it executes many smaller circuits between the sea and the land. At the same time, it is the means of forming clouds and rain; and, for this purpose, a perpetual circulation of the watery part of the atmosphere goes on between its lower and upper regions. Besides this complication of circuits, it exercises a more irregular agency in the occasional winds which blow from all quarters, tending perpetually to restore the equilibrium of heat and moisture. But this incessant and multiplied activity discharges only a part of the functions of the air. It is, moreover, the most important and universal material of the growth and sustenance of plants and animals; and is for this purpose every where present, and almost uniform in its quantity. With all its local motion, it has also the office of a medium of communication between intelligent creatures, which office it performs by another set of motions, entirely different both from the circulation and occasional movements already mentioned; these different kinds of motions not interfering materially with each other; and this last purpose, so remote from the others in its nature, it answers in a manner so perfect and so easy, that we cannot imagine that the object could have been more completely attained, if this had been the sole purpose for which the atmosphere had been created. With all these qualities,

this extraordinary part of our terrestrial system is scarcely ever in the way; and when we have occasion to do so, we put forth our hand and push it aside, without being aware of its being near us."

FIRST WEEK—SATURDAY.

IGNIS FATUUS

One of the curious atmospheric phenomena of winter, the nature of which is not well understood, and still less its use in the economy of Providence, is that shining vapour which generally makes its appearance in moist weather, in marshy ground, known to the Romans by the name of *ignis fatuus*, and called by people in this country "Will o' Wisp;"—"Jack with the lanthorn;" and a variety of other names, all of them indicating the superstitious feelings with which it is associated in the minds of the vulgar. This paper shall be chiefly occupied with some accounts that have been published of the various appearances which the phenomenon assumes. The first I shall quote is that of a writer in a public journal, who subscribes himself "A Farmer," and expresses himself with such amusing naïveté in describing some of the ordinary vagaries of this reputed sprite, that the homeliness of the style seems to require no apology.

"I was riding through a wet boggy part of the road, that lies between my house and the mill, when a little sleety shower, with a strong blast of wind, came suddenly upon me, and made it so very dark, that I could scarcely see my old mare's white head. I began to consider with myself, whether it would be better to turn my back to the storm, and wait till it was past, or take my chance of letting my horse find its own way, when I saw something bright dancing in the air before me. You

may be sure I was startled a little at this; for the rain was pouring so fast, and the wind was blowing so strong, that no ordinary fire could stand it; so I whipt up my horse to get out of the way as fast as I could; but to go fast was out of the question, with such an old mare, such a bad road, and so heavy a burden; and, besides, I soon found that it served me in no stead, for the light still kept waving before my eyes; so I thought it would be best to go slowly, and try if I could find out what it was.

"You may think how surprised I was, when I discovered, that the top of my whip-lash was all in a flame. I had at first almost thrown it out of my hand, in my fright; but, on second thoughts, I did not like to do that, for fear of losing it, as it was nearly new. I therefore whisked it about in my hand, and whipped my horse with it, thinking to make the flame go out; but, though it turned dim for a few minutes, it soon became brighter than ever. Just at this time, I heard the sound of a foot before me; and, when I looked, I saw very distinctly the marks of footsteps all on fire, close beside me; but it was so dark, I could not see whether any person was there or not. Soon afterward, I got upon better road, and my poor mare, who was herself frightened, jogged faster on; so I saw no more of it. I am happy to tell you, that I got home without a broken neck, and found all well there, which was more than I expected; for I verily believed it was a dead light, or an *elf* candle, or some other bad omen."*

M. Beccari mentions, that a light of this kind appeared to a gentleman of his acquaintance, as he was travelling in the neighbourhood of Bologna, where they are very common. It moved constantly before him, for about a mile, and gave a better light than a torch that was carried by his servant. Sometimes it rose and sometimes sunk, but hovered commonly about six feet from the ground. Sometimes it appeared like waves, and at

* Dumfries Courier, 20th December 1809.

other times, seemed to drop sparks of fire. It was little affected by the wind; but, during a shower of rain, it became brighter.

A very remarkable account of a will o' wisp, is given by Dr Shaw, in his Travels to the Holy Land. It appeared in one of the valleys of Mount Ephraim, and attended him and his company for more than an hour. Sometimes it would seem globular, or in the shape of the flame of a candle. At other times, it would spread to such a degree as to involve the whole company in a pale inoffensive light, then contract itself, and suddenly disappear; but, in less than a minute, would appear again. Sometimes, running swiftly along, it would expand itself, at certain intervals, over more than two or three acres of the adjacent mountains. The atmosphere, from the beginning of the evening, had been remarkably thick and hazy; and the dew, as they felt it on the bridles of their horses, was clammy and unctuous.

In the Appendix to Dr Priestley's third volume of Experiments and Observations on Air, M. Waltire gives an account of some very remarkable *ignes fatui* which he observed, about five miles from Birmingham, on the 12th December 1776, before daylight in the morning. A great many of these lights were playing in a neighbouring field, in different directions; from some of which there suddenly sprang up bright branches of light, something resembling the explosion of a rocket, that contained many brilliant stars; and the hedge, with the trees on each side of the hedge, were illuminated. This appearance continued but a few seconds, and then the will o' wisps played as before. M. Waltire was not near enough to observe if the apparent explosions were attended by any report.

From these and other facts which have been recorded, and indeed from the familiar occurrences of the winter months, it appears that the *ignis fatuus* belongs to a class of phenomena which prove that light and heat, though so intimately connected, may exist separately; or, to

speak more correctly, that the peculiar substance, whatever it may be, in which these qualities inhere, contains sometimes the one in a latent state, and sometimes the other. This is only another remarkable property of that most wonderful substance which seems to pervade universal nature, and to combine the various phenomena of electricity, of galvanism, and probably also of magnetism, along with those of light and heat, sometimes in a quiescent, and sometimes in a highly active state.

The phenomena of light without heat, are not so frequently the subject of observation as those of heat without light; but various well known, and indeed familiar, instances of the latter do occur. Of this kind is the light of the glow-worm, of fire-flies, of the medusa tribe, which are diffused so plentifully over the surface of the sea, in tropical regions; of other marine productions; of the scales of fish, and of animal and vegetable substances in the act of putrefaction. Nor must we forget the beams of the moon, which, so far from exhibiting the presence of heat, are even said by some to be slightly frigorific.

An attempt, more ingenious, I think, than successful, has been made to connect the light of of the *ignis fatuus* with the phenomena of falling stars, which may be shortly stated. It is supposed, that some phosphoric fluid, arising from the decomposition of animal or vegetable substances, passes into the atmosphere, and continues to float there, without mixing with the atmosphere itself; that this fluid, when it appears in the form of a will o' wisp, becomes ignited, by some means, near the surface of the earth, at a certain point; and that this ignition communicates itself successively to other portions of the same fluid, with which it comes in contact, occasioning that apparently capricious flitting from place to place, for which this meteor is remarkable; and it is further supposed, that other portions of a similar fluid pass, unilluminated, to the higher regions of the air, in a continued column, till they ascend above the region of the

clouds, where, from some chemical cause, the upper part of the column takes fire, and the ignition is carried backward to the portions with which it is in connexion. Such is the hypothesis; and it might certainly account for some of the appearances; but it is quite inadequate to the explanation of others; and, as to the phenomena of falling stars, recent discoveries have opened up views on that subject, of a nature far more extensive and sublime.

In the next paper, I shall advert more particularly to some phosphorescent appearances which seem to resemble those of the *ignis fatuus*, and which may perhaps ultimately assist in discovering the natural cause of the phenomenon; and, in the mean time, without attempting to explain it, I shall merely say, that, whatever may be its own sphere of utility, there can be no doubt it is connected with a principle which abundantly exhibits the perfections of the great Creator.

We conclude this account with a beautiful description of these appearances, extracted from the "British Georgics," a work of the amiable author of "The Sabbath."

"Sometimes November nights are thick bedimmed
With hazy vapours floating o'er the ground,
Or veiling from the view the starry host;
At such a time, on plashy mead or fen
A faintish light is seen, by southern swains
Called Will-o-Wisp; sometimes from rushy bush
To bush it leaps, or, cross a little rill,
Dances from side to side in winding race.
Sometimes with stationary blaze it gilds
The heifer's horns; or plays upon the mane
Of farmer's horse returning from the fair,
And lights him on his way, yet often proves
A treacherous guide, misleading from the path
To faithless bogs, and solid seeming ways.
Sometimes it haunts the churchyard, up and down
The tombstones' spiky rail streaming, it shows
Faint glimpses of the rustic sculptor's art,

Time's scythe and hour-glass, and the grinning skull,
And bones transverse, which, at an hour like this,
To him, who passing, casts athwart the wall
A fearful glance, speak with a warning knell.
Sometimes to the lone traveller it displays
The murderer's gibbit, and his tatter'd garb,
As lambently along the links it gleams."

SECOND WEEK—SUNDAY.

GENERAL ASPECT OF WINTER.

The general aspect of winter is forbidding. It is the night of the year: the period when, under a mitigated light, nature reposes, after the active exertions of spring and summer have been crowned with the rich stores of autumn. We now no longer survey with admiration and awe those wonders of creative power which arrested our attention in that youthful season, when herbs, plants, and trees awoke from their long sleep, and started into new life, under the kindly influences of warmer suns and gentler breezes; and when the feathered tribes made the fresh-clothed woods and lawns, and the blue sky itself, vocal with the music of love and joy. Nor do we now expatiate in the maturer beauties of summer, when light and heat flushed the glowing heavens and smiling earth, and when the clouds distilled their grateful showers, or tempered the intense radiance by their flitting shade: And mellow autumn too has passed away, along with the merry song of the reapers, and the hum of busy men, gathering their stores from the teeming fields.

Instead of these genial influences of a propitious heaven, our lengthening nights, and our days becoming perpetually darker and shorter, shed their gloom over the face of nature; the earth grows niggardly of her supplies of nourishment and shelter, and no longer spreads beneath the tenants of the field the soft green carpet on which they were accustomed to repose; man seeks his artificial comforts and his hoarded food; the wind whistles ominously through the naked trees; the dark clouds lower; the chilling rain descends in torrents; and, as the season advances, the earth becomes rigid, as if struck by the wand of an enchanter; the waters, spell-bound, lie

motionless in crystal chains; the north pours forth its blast, and nature is entombed in a vast cemetery, whiter and colder than Parian marble.

Yet, even in this apparently frightful and inhospitable season, there are means of pleasure and improvement, which render it scarcely inferior to any other period of the revolving year; while proofs of the power, wisdom, and goodness of the great Creator are not less abundantly displayed to the mind of the pious inquirer. With reference to the angry passions of the human race, it is said that God "causes the wrath of man to praise him, and restrains the remainder of wrath;" and a similar remark applies with a truth equally striking to the troubled elements. The Almighty sets bounds to the raging ocean, saying, "Hitherto shalt thou come, and no farther, and here shall thy proud waves be stayed." He regulates by his wisdom the intensity of the tempest, "staying his rough wind in the day of the east wind." All the active powers of nature are his messengers: "Fire and hail, snow and vapour," as well as "stormy winds, fulfil his word." Nothing, indeed, can be more worthy of admiration and gratitude than the manner in which the rigours of winter are tempered and modified, so as to contribute to the subsistence and comfort of living beings.

It is true that, even in the ordinary occurrences of life, there are, in winter, probably more distressing and fatal incidents than during the other quarters of the year. A snow-storm may sometimes overwhelm a shepherd and his flock; a tempest may cause a gallant vessel and its crew to perish; a fire may lay a village in ashes; disease, attendant on exposure to a rigorous climate, may invade the unwholesome and comfortless huts of the poor; or, in a season when the wages of agricultural labour cease along with the power of working in the open air, famine may emaciate and destroy whole families; but such events as these, melancholy as they are, must be ranked among the common evils of life, and

belong to a class, marking a peculiar feature in the government of this fallen world, to which I have previously adverted, and which can never be far from the mind of the accurate observer of nature. At present let us take a rapid glance at the other side of the picture, and we shall see enough to prove, that, even in these gloomy months, the paternal care of an all-wise and beneficent Governor is not less conspicuous than in other periods of the changing year.

If we look at the lower animals, how wonderful are the kind provisions of Providence. Among the numerous tribes of insects, reptiles, birds, and quadrupeds, there appears to be a general presentiment of the coming desolation. Some, impelled by a wonderful instinct, provide for themselves comfortable retreats, each tribe adapting its accommodation to its peculiar circumstances, burrowing in the earth, or boring beneath the bark of trees and shrubs, or penetrating into their natural hollows, or lodging in crevices of walls and rocks, or diving beneath the surface of the water, and lying immoveable at the bottom of pools, lakes, or marshy streams. Here they are preserved during this barren period, either by feeding on the stores which, with a foresight not their own, they had collected in the bountiful weeks of harvest, or by falling into a deep sleep, during which they become unassailable either by the attacks of cold or of hunger, or by issuing daily or nightly from their resting places, and gathering the food which a providential care has reserved for them, and taught them how to seek. Others, chiefly belonging to the winged tribes, are taught to migrate, as the rigours of winter approach, to more genial climates, where abundant food and enjoyment are provided for them, and where they are thus permitted to expatiate in all the advantages of a perpetual yet varied summer; while, these, again, have their places supplied by hardier species of the feathered family, which the gathering storms of more northern regions had warned to leave their summer haunts.

If, from the inferior animal creation, we turn to man, the same traces of a paternal hand are seen in providing against, or compensating for, the privations of winter. If our natural instincts and defences are not so numerous as those of the brutes, reason and foresight amply supply their place. Influenced by these, we build comfortable houses, of materials which are every where to be found, and collect supplies of fuel from bogs and forests, or dig them out of the bowels of the earth, where they are laid up as in storehouses; and we rear flocks and herds to furnish us with the means of food and clothing. Meanwhile, necessary industry occupies and cheers the dreary season; and books or social intercourse improve and exhilarate the mind.

All these proofs of paternal care deserve and will obtain a separate consideration; but the simple mention of them is calculated to call forth sentiments of pious admiration and gratitude. "Who knoweth not in all these, that the hand of the Lord hath wrought this."

SECOND WEEK—MONDAY.

PHOSPHORESCENCE.

The meteor known by the name of *ignis fatuus*, is connected, as I observed in the paper of Saturday, with some other luminous appearances, by this common property, that it gives out no sensible heat. Among other animals which possess the property of shining with a cold light, I mentioned the Medusa class, which sometimes illuminate the whole surface of the sea, and, in a dark night, show like a stream of liquid fire in the wake of a ship. But, besides these, there is a great variety of the larger inhabitants of the ocean, which have it in their power to emit a kind of phosphoric light from their bodies at pleasure; and this remarkable property is pro-

bably given them by the Creator, to enable them to pursue their prey in the dark abysses of the sea, where the beams of the sun cannot penetrate. Among shoals of herrings and pilchards, flashes of light have been frequently observed to dart, so as to cast a sudden brilliancy across the whole; and oyster-shells, as well as a variety of minerals, have become phosphorescent at certain temperatures. These appearances have been attributed to electricity, which is rendered probable by various circumstances, and seems to be confirmed by the fact, that the electric shock causes substances of the kind last mentioned, to exhibit the same luminous appearance. However this may be, there can be no doubt, that the presence of the electric fluid is not unfrequently shown by the production of a harmless light, similar to that of the *ignis fatuus*. Sailors are not unacquainted with this phenomenon, which they regard with awe, and which is seen at night in the form of a star, illuminating the top-masts and yard-arms, or gliding along the ropes of ships. This light the ancients superstitiously distinguished by the name of Castor and Pollux, considering it a lucky omen. Mrs Somerville mentions, that, in 1831, the French officers at Algiers were surprised to see brushes of light on the heads of their comrades, and at the points of their fingers, when they held up their hands.

One of the most striking appearances of this kind, which occurred at sea, is thus graphically described by the talented authoress above alluded to:—

"Captain Bonnycastle, coming up the Gulf of St Laurence, on the 7th September 1826, was roused by the mate of the vessel, in great alarm from an unusual appearance. It was a star-light night, when suddenly the sky became overcast, in the direction of the high land of Cornwallis County, and an instantaneous and intensely vivid light, resembling the aurora, shot out of the hitherto gloomy and dark sea, on the lee-bow, which was so brilliant, that it lighted every thing distinctly, even to

the mast-head. The light spread over the whole sea, between the two sheres, and the waves, which before had been tranquil, now began to be agitated. Captain Bonnycastle describes the scene as that of a blazing sheet of awful and most brilliant light. A long and vivid line of light, superior in brightness to the parts of the sea not immediately near the vessel, showed the base of the high, frowning, and dark land, abreast. The sky became lowering, and more intensely obscure. Long tortuous lines of light showed immense numbers of very large fish, darting about, as if in consternation. The spritsail-yard and mizen-boom were lighted by the reflection, as if gas-lights had been burning directly below them; and, until just before day-break, at four o'clock, the most minute objects were distinctly visible. Day broke very slowly, and the sun rose of a fiery and threatening aspect. Rain followed. Captain Bonnycastle caused a bucket of this fiery water to be drawn up: it was one mass of light, when stirred by the hand, and not in sparks, as usual, but in actual coruscations. A portion of the water preserved its luminosity for seven nights. On the third night, the scintillations of the sea reappeared; this evening, the sun went down very singularly, exhibiting in its descent a double sun; and, when only a few degrees high, its spherical figure changed into that of a long cylinder, which reached the horizon. In the night, the sea became nearly as luminous as before; but, on the fifth night, the appearance entirely ceased. Captain Bonnycastle does not think it proceeded from animalcula, but imagines it might be some compound of phosphorus, suddenly evolved, and dispersed over the surface of the sea; perhaps from the exuviæ or secretions of fish connected with the oceanic salts,—muriate of soda, and sulphate of magnesia."*

Such are some of the facts connected with what has been called phosphorescence. I shall make no attempt to theorize on the subject. When science is farther ad-

* "Connexion of the Physical Sciences," pp. 303, 304.

vanced, it may probably be found, that phosphorescence, the *ignis fatuus*, and other innoxious illuminating substances, depend on some common property, which may serve to illustrate the mysterious subject of light and heat, and thus open up a further view of the laws by which the Creator regulates the material world.

SECOND WEEK—TUESDAY.

AURORA BOREALIS.

The aurora borealis is a phenomenon undoubtedly electrical, connected in some way with the magnetic poles, which sometimes beautifully illuminates our northern sky during the autumnal and winter months. Its use in the system of nature has not been distinctly ascertained, though various conjectures have been formed. Dr Halley supposed that the earth was hollow, having within it a magnetical sphere, which corresponded in virtue with all the magnets on the surface; and that the aurora was the magnetic effluvia rendered by some means visible, and passing through or beyond the atmosphere from the north pole of the central magnet to that of the south. Boccaria adopts a similar idea, but attributes the phenomenon to the electric instead of the magnetic fluid, which, indeed, is now proved to be the same thing. The fallacy of this opinion has, however, been since shown by the fact, that the fluid, whatever it is, darts upward toward the zenith in the southern as well as in the northern hemisphere, whereas, were there a circulation such as has been conjectured, the course of the fluid would in the south have been reversed, descending from the zenith to the horizon. The supposition of Dr Faraday, therefore, is, that the electric equilibrium of the earth is restored by the aurora conveying the electricity from the poles to the equator.

Without attempting to settle a point with regard to

which sufficient data have not been collected, I shall content myself with describing some of the remarkable appearances of this very curious and interesting phenomenon.

One circumstance worthy of notice has already been stated, namely, that the aurora bears some reference, not to the poles of the earth's rotation, but to what have been called the magnetic poles. It generally forms a kind of stationary luminous arch, of which the magnetic pole is the centre, and across this arch the coruscations are rapid, sudden, and frequently of various colours. Its history is curious, no very distinct account having been recorded of its appearance in the classic ages of the world, though we do hear of "*trabes*," and "*bolides*," and "*chasmata*," which seem to refer to some celestial phenomena of a similar nature. The first modern account of the aurora on record, is that mentioned as having been seen at London, on the 30th January 1560, and during the subsequent part of that century; its appearance does not seem to have been very uncommon. During the seventeenth century, however, it appears to have been scarcely observed at all, except in one instance, in 1621, when it excited the astonishment of the inhabitants of France, and first acquired the name of the aurora borealis. Since the beginning of the eighteenth century, its visits in this and other northern countries have been frequent but capricious, there being intervals of several years, during which they have been either intermitted altogether, or have been of such a nature as to attract little observation.

In the northern regions, the aurora appears with the greatest brilliancy; but it does not seem that the intenseness increases, as might be expected, in proportion to the nearness of approach to the magnetic pole. In the Shetland Islands, it cheers the winter nights almost constantly during clear weather. These phenomena are there called the *merry dancers*, and are thus described: "They commonly appear at twilight, near the horizon,

of a dun colour, approaching to yellow; sometimes continuing in that state for several hours, without any sensible motion; after which they break out into streams of stronger light, spreading into columns, and altering slowly into ten thousand different shapes, varying their colours from all the tints of yellow to the obscurest russet. They often cover the whole hemisphere, and then make the most brilliant appearance. Their motions, at these times, are amazingly quick, and they astonish the spectator with the rapid change of their form. They often put on the colour of blood, and make a most dreadful appearance."*

The aurora is said, in the colder latitudes, to be attended with a peculiar hissing noise. Gmelin mentions this very distinctly and positively in the interesting account which he gives of it, as it appears in Siberia. "These northern lights," says he, "begin with single bright pillars, rising in the north, and almost at the same time in the north-east, which, gradually increasing, comprehend a large space of the heavens, rush about from place to place, with incredible velocity, and finally almost cover the whole sky, up to the zenith. The streams are then seen meeting together in the zenith, and produce an appearance as if a vast tent was expanded in the heavens, glittering with gold, rubies, and sapphires. A more beautiful spectacle cannot be painted; but, whoever should see such a northern light, for the first time, could not behold it without terror; for however fine the illumination may be, it is attended, as I have learned from the relation of many persons, with such a hissing, cracking, and rushing noise throughout the air, as if the largest fireworks were playing off. To describe what they then hear, they make use of the expression *spolochi chodjat;* that is, the raging host is passing. The hunters who pursue the white and blue foxes, in the confines of the Icy Sea, are often overtaken in their course by these northern lights. Their dogs are then so much

* Encyclopedia Britannica, article Aurora Borealis.

frightened, that they will not move, but lie obstinately on the ground till the noise has passed. Commonly clear and calm weather follows this kind of northern lights. I have heard this account, not from one person only, but confirmed by the uniform testimony of many, who have spent part of several years in these very northern regions, and inhabited different countries, from the Yenesei to the Lena; so that no doubt of its truth can remain."

In Captain Franklin's narrative of his journey to the Polar Sea, there are some scientific observations on the phenomena of the Aurora, which throw considerable light on this curious and interesting subject. The meteor is usually conceived to have its place very high above the earth; but exceedingly different elevations have been assigned to it by different philosophers. Euler supposed it to be some thousands of miles distant, others have fixed its place at a few hundred miles, and others again much lower. The diffused nature of the appearance in this country, renders it difficult to make any accurate observation on the subject; but if the Aurora should continue occasionally to assume the form of a moveable luminous arch, gliding slowly in a well defined continuous body towards the zenith, as it has lately done in several instances and in different seasons, observations taken from various stations might settle the point. Be this as it may, and however high the northern lights may actually be in this comparatively southern latitude, it seems to be ascertained by Captain Franklin and his companions, that, in the higher latitudes of North America, and still nearer the Pole, the region of the Aurora is not many miles above the earth. They discovered, by actual observation, that, in several instances, it did not rise higher than six or seven miles; and both there and in Siberia, it would seem to be often much lower even than this. The same kind of appearances, as are described by Gmelin, above quoted, appear sometimes to occur on the other side of the Atlantic.

These, however, are not frequent; and the more usual phenomena partake much of the nature of the following, which I quote from Mr Richardson's interesting observations on this meteor:—

"When the Aurora had exhibited itself in this form for a considerable space of time, the whole mass of light suddenly appeared in motion, and, sweeping round on each side, was gathered together to the southward of the zenith. Immediately thereafter, a large portion of it was seen in the S.E., assuming an exact resemblance to a curtain suspended in a circular form in the air, and hanging perpendicularly to the earth's surface. The lower edge of this curtain was very luminous, and had a waving motion; and the illusion was farther heightened by the momentary appearance of perpendicular dark lines or breaks in the light, in rapid succession round the circle, exactly as the waving of a curtain would cause the dark shades of its folds to move along it. This beautiful curtain of light was about 40° high, and of a pale yellowish colour, and sent forth on the one side a process which approached the S.E. by E. point of the horizon, and the other was connected with a long regular arch, terminating in the N.W. horizon, similarly constructed, and having the same waving motion with the curtain itself. All this time the sky was perfectly clear, except in the southern quarter, which, to the height of 4° or 5°, was occupied by dark clouds, apparently intermediate between stratus and cirro-stratus.

"Half an hour after its first appearance, this curtain-formed Aurora was resolved into a number of detached irregular portions, which sometimes increased rapidly in every direction, until they met with other masses, either before existing, or appearing at the instant, and formed an uniform sheet of light, which covered the whole sky. The formation of this great sheet of light was so rapid, that the eye could only trace its progress partially, and its dissolution and reappearance were equally sudden."*

* Franklin's Narrative, p. 621.

SECOND WEEK—WEDNESDAY.

METEORIC SHOWERS.

I HAVE now to mention another celestial phenomenon of a very singular nature, connected with two days in the present week, which has lately attracted the attention of the scientific world. The following account of it I extract from Mrs Somerville's "Connexion of the Physical Sciences."

"On the morning of the 12th of November 1799, thousands of shooting stars, mixed with large meteors, illuminated the heavens for many hours, over the whole continent of America, from Brazil to Labrador; it extended to Greenland, and even Germany. Meteoric showers were seen off the coast of Spain, and in the Ohio country, on the morning of 13th November 1831; and during many hours on the morning of 13th November 1832, prodigious multitudes of shooting stars and meteors fell at Mocha, on the Red Sea, in the Atlantic, in Switzerland, and at many places in England. But by much the most splendid meteoric shower on record, began at 9 o'clock in the evening of 12th November 1833, and lasted till sunrise next morning. It extended from Niagara and the northern lakes of America, to the south of Jamaica, and from 61° of longitude in the Atlantic, to 100° of longitude in Central Mexico. Shooting stars and meteors, of the apparent size of Jupiter, Venus, and even the full moon, darted in myriads toward the horizon, as if every star in the heavens had started from their spheres. They are described as having been as frequent as flakes of snow in a snow-storm, and to have been seen with equal brilliancy over the greater part of the continent of North America.

"Those who witnessed this grand spectacle, were surprised to see that every one of the luminous bodies, without exception, moved in lines, which converged in one

point in the heavens; none of them started from that point; but their paths, when traced backward, met in it, like rays in a focus, and the measure of their fall showed that they descended from it in nearly parallel straight lines toward the earth.

"By far the most extraordinary part of the whole phenomenon is, that this radiant point was observed to remain stationary near the star γ Leonis, for more than two hours and a half, which proved the source of the meteoric shower to be altogether independent of the earth's rotation, and its parallax showed it to be far above the atmosphere.

"As a body could not be actually at rest in that position, the group must either have been moving round the earth or the sun. Had it been moving round the earth, the course of the meteors would have been tangential to its surface, whereas they fell almost perpendicularly, so that the earth, in its annual revolution, must have met with the group. The bodies that were nearest, must have been attracted toward the earth by its gravity; and as they were estimated to move at the rate of fourteen miles in a second, they must have taken fire on entering our atmosphere, and have been consumed in their passage through it.

"As all the circumstances of the phenomenon were similar, on the same day, and during the same hours, in 1832, and as extraordinary flights of shooting stars were seen at many places, both in Europe and America, on 13th November 1834, tending also from a fixed point in the constellation Leo, it has been conjectured, with much apparent probability, that this group of bodies performs its revolution round the sun in a period of about 182 days, in an elliptical orbit, whose major axis is 119,000,000 of miles; and that its aphelion distance, where it comes in contact with the earth's atmosphere, is about 95,000,000 of miles, or nearly the same with the mean distance of the earth from the sun."*

* Mrs Somerville on the Physical Sciences, pp. 404-5.

This account, and these views, given by this talented lady, correspond with those of the most celebrated living astronomers. M. Arago, from the facts mentioned, concludes that "a new planetary world is about to be revealed to us;" and, at all events, there does seem to be a stream of innumerable bodies, comparatively small, but of various dimensions, moving constantly round the sun, whose orbit cuts that of our earth, at the point which it occupies, on the 12th or 13th of November every year. For any thing that we can tell, indeed, there may be vast numbers of bodies circling round the sun, and even round the earth itself, which, on account of their minuteness and opacity escape human observation. Such a supposition serves to explain the meteoric appearances which are constantly occurring in the clear nights of winter, and which would probably be not less common in summer, were the operations in the upper regions equally visible at that season.

Falling stars would seem to be nothing else than bodies of this description, rendered visible from being ignited by the rapidity of their passage through our atmosphere, or by some chemical cause; and meteoric stones, the fall of which is much more frequent than is commonly supposed, may be accounted for in the same way. Some of the latter are of great magnitude, exceeding, in certain instances, seventy miles in diameter. Mrs Somerville mentions one which passed within twenty-five miles of us, and was estimated to weigh about 600,000 tons, and to move with a velocity of about twenty miles in a cond. This huge mass was providentially prevented fro striking the earth, a detached fragment of it alone having yielded to the force of our planet's gravitation. It is remarkable, that the chemical composition of these meteoric stones, while it materially differs from that of the ordinary strata of our globe, is uniform and almost identical as regards themselves.

What part these mysterious bodies act in the system of the universe, we cannot tell,—perhaps we may never

be able even to conjecture; but we may well learn from the analogy of objects with which we are acquainted, that even they are not useless appendages of our solar system; and, at all events, we are bound confidently to believe that such bodies are as much under the control of the Creator, as every other part of the creation, and can never, independent of the divine fiat, disturb the equilibrium of our planet, or interfere with the happiness of its inhabitants. It is the delightful result of religious belief to be assured, that, however threatening may be the aspect assumed by scientific discoveries, there is not an object in nature left to the reckless sway of chance;—that all things are adjusted with unerring wisdom, managed by infinite power, and overruled for good with paternal care.

SECOND WEEK—THURSDAY.

VARIETY OF CLIMATES.

THE difference of climates arises, as I have already observed, from the spherical figure and inclined position of the earth, which turns a single ring on its surface to the direct rays of the sun, oscillating between two defined limits, and subjects all the rest, more or less, to his oblique, and therefore less powerful, influence. The effect of this is, the production of all the varieties of heat and cold, from the fervid glow of the tropics, to the perpetual ice and snow in the regions of the poles. The adaptation of plants and animals to these diversities, forms a most curious and interesting subject of consideration, which will be afterward examined with reference to the respective seasons; but as allusion has, in a preceding paper, been made to the advantages derived from a variety of climates, a few observations at present on these advantages seem not to be out of place.

It has been with truth observed, that the development of the human powers depends mainly upon our wants, either natural or artificial, and these again are increased or restrained in proportion to the means of indulgence, so that the influence is reciprocal. We are naturally indolent, but stand in need of activity, for giving vigour both to our mental and physical powers. We, therefore, require a strong stimulus to exertion; and that stimulus is to be found in our wants, a circumstance which has given rise to the well-known proverb, —Necessity is the mother of invention.

Were all the productions of the earth to be spontaneous and abundant, it may well be questioned if man would ever rise above the level of the most degraded savage. This observation is strikingly sustained and illustrated by history, which informs us that a prostration of all the energies of body and mind has been uniformly found among the native inhabitants of tropical regions, where nature is lavish of her stores, and that it is to the dwellers in countries where the necessaries of life are more scantily produced, that we are to look for a race, hardy, vigorous, and intelligent. To what extent the direct influence of an intense heat co-operates with the more indirect cause we are now considering, in producing this inervated state, it may be difficult to determine; but that it is not the only, or indeed the chief agent, cannot be doubted While the natives of regions where plenty reigns, indulging their natural appetites without exertion and without restraint, sink deeper and deeper in indolence and effeminacy, those of less bountiful regions, finding an increased population pressing hard on the means of subsistence, are stimulated by their wants to vigorous exertion, and from sheer necessity are rendered active, ingenious, and enterprising. Among the first effects, which history describes as produced by this difference in character and circumstances, are the warlike irruptions of the hardy tribes of the north on the luxurious inhabitants of the south, accompanied by ex-

tensive conquests, and ending in the permanent settlement of these nations in the fertile regions, of which they have taken forcible possession. The stimulus which was thus given to the human faculties, has frequently been permanent, and has produced extensive, and eventually important, consequences on the improvement of the species.

This, however, is mentioned only incidentally, my object at present being merely to show the salutary effect of a limited and comparatively scanty supply of the necessaries of life, arising from what may, as regards production, be considered an unfavourable climate. But this remark has its limitations; and I must not neglect to state, that cold and consequent privation, when carried to an extreme, have a depressing effect of a different kind. The natives of Greenland, and the other countries bordering on the Arctic Circle, are not less degraded in the scale of intellect than the Negro race in the teeming wilds of Africa. It is in the regions within the Temperate Zone that the mind of man, along with his bodily powers, seems most freely and vigorously to expand. He is here situated in regions not only peculiarly suited to his bodily constitution, but to the development of his moral and intellectual faculties. The variety of climate, alternating between moderate heat and mitigated cold, while it requires attention to the comforts of clothing and habitation in their adaptation to the changes of the seasons, and thus exercises his ingenuity, presses still more powerfully on the resources of his mind, by the cessation, during a considerable part of the year, of that supply of the necessaries of existence, which, at another season, is afforded in comparative abundance. Under the influence of these circumstances, man becomes, by a kind of moral and physical necessity, a *storing* animal, and habits of forethought, thus engendered, are strengthened and increased by exercise, till the mercantile spirit is produced.

The same tendency is encouraged by the diversified

productions of different soils, of changing seasons, of various elevations from the mountain to the valley, of adjoining islands and continents, and even of more distant regions. Placed in the middle, between the two extremes of climate, the productions of the north and of the south are equally within reach of the inhabitant of the temperate zones; and experience soon teaches him the enjoyment and comfort of accumulating from both quarters. The neighbourhood of seas, lakes, and rivers, contributes much to the fostering of this spirit, by affording facilities of intercourse which could not otherwise be obtained; and, accordingly, we find that the early efforts of commercial enterprise have been chiefly confined to such localities, or at least have derived their origin or their stimulus from them. It is true, that the first traders of whom we read, were among the descendants of Ishmael, a wandering and active inland tribe; but it was to the maritime land of Egypt that they were directing their course for conducting their petty traffic. The rise of the mercantile spirit in that country is easily accounted for, on the principles to which we have adverted. Situated on the banks of the Nile, a navigable river, with the Red Sea toward the south, and the broad Mediterranean toward the north, there is no wonder that the Egyptians should have been among the most early and most successful merchants of ancient times. A similar remark may apply to Tyre, Sidon, and Carthage, the other cities of antiquity, where the mercantile spirit prevailed. And, indeed, it is impossible not to regard the subsequent civilization of European nations, surrounded as they are by facilities for navigation, and situated in a climate possessing all the properties we have described, as the natural, or rather providential, result of the same principles.

SECOND WEEK—FRIDAY.

PRACTICAL EFFECT OF THE COMMERCIAL SPIRIT PRODUCED BY A VARIETY OF CLIMATES.

It would be very interesting to trace the progress of a mercantile spirit, arising from the wants of one climate, and the superabundance of another; but this is a speculation which the nature of this work will not permit us to pursue in its various bearings; and I must confine myself to a rapid view of the practical effects actually produced by it in European countries, and especially in our own.

The desire to possess, when once thoroughly awakened, becomes insatiable; and this, again, gives a proportional stimulus to the spirit of enterprise which induces the traveller to urge his discoveries, and the trader to compass sea and land in the transport of produce from country to country; while the artificer, the manufacturer, and the agriculturalist, each in his own department, exert their industry, skill, and ingenuity, in turning to account the knowledge and the materials which thus flow in upon them. It is because neither the climate nor the soil of any one country is naturally suited to the production of all the luxuries and conveniences which man covets, and because, even where these objects of desire might be produced by human industry, they are not naturally to be found, that the intercourse between distant countries takes place, on which so much of the civilization of the world depends. The ingenuity of man being thus stimulated, produces the most surprising changes, and promotes, in an astonishing degree, the means of human subsistence and enjoyment. It is not merely that the varied riches of other lands are imported, but that an essential alteration is effected in the actual produce of the soil.

It is a remarkable fact, noticed by Mr Whewell, that where man is an active cultivator, he scarcely ever bestows much of his care on those vegetables which the land would produce in a state of nature. He improves the soil, he even improves the climate, by his skilful labours, and he thus renders both fit for sustaining and nourishing more useful plants. He, therefore, does not generally select some of the natural productions, and improve them by careful culture, but, for the most part, he expels the native possessors of the land, and introduces colonies of strangers. This remark he proceeds to exemplify in the condition of our own part of the globe.

"Scarcely one of the plants," he says, "which occupy our fields and gardens, is indigenous to the country. The walnut and the peach come to us from Persia; the apricot from Armenia. From Asia Minor and Syria, we have the cherry-tree, the fig, the pear, the pomegranate, the olive, the plum, and the mulberry. The vine which is now cultivated, is not a native of Europe; it is found wild on the shores of the Caspian, in Armenia, and Caramania. The most useful species of plants, the *cereal* vegetables, are certainly strangers, though their birthplace seems to be an impenetrable secret. Some have fancied that barley is found wild on the banks of the Semara, in Tartary; rye in Crete; wheat at Baschkiros, in Asia; but this is held by the best botanists to be very doubtful. The potato, which has been so widely diffused over the world, in modern times, and has added so much to the resources of life in many countries, has been found equally difficult to trace back to its wild condition."*

"In our own country," Mr Whewell goes on to observe, "a higher state of the arts of life is marked by a more ready and extensive adoption of foreign productions. Our fields are covered with herbs from Holland,

* Whewell's Bridgewater Treatise, p. 71 —He observes in a note, that it appears now to be ascertained that the edible potato is found wild in the neighbourhood of Valparaiso.

and roots from Germany; with Flemish farming, and Swedish turnips; our hills with forests of the firs of Norway. The chestnut and the poplar of the south of Europe adorn our lawns, and below them flourish shrubs and flowers, from every clime, in profusion. In the mean time, Arabia improves our horses, China our pigs, North America our poultry, Spain our sheep, and almost every country sends its dog. The products which are ingredients in our luxuries, and which we cannot naturalize at home, we raise in our colonies; the cotton, coffee, and sugar of the east, are thus transplanted to the farthest west; and man lives in the midst of a rich and varied abundance, which depends on the facility with which plants and animals, and modes of culture can be transferred into lands far removed from those in which nature had placed them. And this plenty and variety of material comforts is the companion and the mark of advantages and improvements in social life, of progress in art and science, of activity of thought, of energy of purpose, and of ascendancy of character."

This splendid display of the effects of commercial and agricultural intercourse, which might easily be enlarged, depending, as that intercourse mainly does, on the influence, direct and indirect, of varieties of climate on the surface of the earth, serves to show a wise and beneficent intention in so unequal a distribution of temperature, and brings us back to the conclusion, that whatever partial inconveniences may accompany such arrangement, these are vastly counterbalanced by the advantages of which it is productive. If it be true, as it undoubtedly is, that much of the activity, ingenuity, and intelligence, which exist in the world, had their first development in the circumstances attending the differences in question; and if the very wants and privations of a less genial climate have eventually, not merely, improved the intellectual character of men, but bound them together by new and intimate ties, from the equator to the vicinity of the poles, how can we avoid the inference, that such

extensive and important results were contemplated and provided for by the Divine Mind, in establishing the relations between the natural and moral worlds.

SECOND WEEK—SATURDAY.

ADAPTATION OF ORGANIZED EXISTENCES TO SEASONS AND CLIMATES.

The adaptation of plants and animals to the changes of the seasons, which, taken even in the broad and general view, is so clear an indication of an intelligent Designing Cause, is no where more conspicuous than in the season of winter. Were but a strong and continuous blast of the breath of winter to pass over our forests, fields, and gardens, in any of those months when vegetation is in its glory, and when animated nature luxuriates in universal plenty, the effect would be most disastrous. All organized existences would feel the fatal shock. Leaves, and fruits, and flowers, would shrink, wither, and decay; insects on the wing would fall lifeless to the earth; the various species of caterpillars would drop stiff and dying from the frozen vegetables on which they fed; even the larger animals would be stricken with the general blight; birds and beasts, if they did not instantly perish, would droop and shiver; and even man himself, adapted as his constitution is to sustain the rigours of all climates, would find himself invaded by deadly diseases. Nor would the evil end here. Not only would individuals die, but whole species would become extinct. The seeds, and eggs, and larvæ, which propagate the various races of plants and insects, would be unproduced. The progress of reproduction would be arrested at its source; and, were the untimely blast to be universal, various links would be broken for ever in the chain of existence.

This consideration brings us, at once, to a clear perception of the kind of adaptation to which I allude. It is evident that some peculiar provision has been made, in temperate climates, for the preservation of organized existences during winter. In that season they are not in the same condition as in other seasons of the year. It is not merely that the change from heat to cold has been gradual. It is true that the hurtful effects of a violent alteration of temperature is thus avoided; and this is something which ought not to be overlooked in the wise provisions of the Author of Nature. But much more than this was necessary; and, as we shall afterward have ample means of observing, has actually been effected. It was requisite, for the preservation both of plants and animals, that, during winter, their habits and functions should be altered, or even suspended, and that peculiar contrivances should be resorted to for protecting them from the rigours of the season.

But there is another consideration which must not be overlooked. Not only are there peculiar provisions for preserving animal and vegetable life, in our temperate climates, during the cold of winter, but the whole classes of organized beings which exist in any climate, are adapted to all the ordinary changes of their peculiar locality; so that the fact I have mentioned, is only a single instance of a principle of adaptation which runs through the whole system. The tropical plants, for example, are peculiarly formed, for the express purpose of living and flourishing under vertical suns, long droughts and periodical rains; the vegetable productions of the polar regions, on the other hand, have their own remarkable contrivances for resisting the chilly influences occasioned by the long absence of the sun, and for starting suddenly into life, and running their short but rapid race, during the few weeks which comprise their spring, summer, and autumn. And so it is also with our temperate climates. It is not in winter, alone, that an adaptation to the season is conspicuous, but throughout every

month of the year. Every parallel of latitude has its peculiarities of weather,—its longer or shorter duration of mildness and of rigour,—of rain and of drought,—of light and of darkness; and to all these varieties, the plants indigenous to the soil are adapted.

But, what is more, under the very same parallel, there are localities which differ materially from the general average of the climate, on account of the elevation of mountain ranges, or other accidental circumstances. Here, again, we find very striking indications of the provident care we have noticed. By whatever mysterious means the distribution has been made, there we find productions suited to the situation. Some extraordinary instances of this have been noticed on the Himalaya mountains, on the Andes, on the Peak of Teneriffe, and, indeed, in all the quarters of the globe where lofty mountain ranges are to be found. The scientific traveller, Humboldt, informs us, that there is upon the earth's surface, a geographical distribution of plants, according to its various climates, which he distinguishes into so many zones of vegetation, from the pole to the equator. In the Island of Teneriffe, he observed that its various heights, which, as in all mountains, are colder as the elevation increases, exhibited differences of plants, corresponding with the temperature; and he divided the various heights into five zones, each clearly marked by their respective vegetations. It has been a matter of curious investigation among philosophers, by what means the earth was at first supplied with productions suited to its respective climates and peculiarities; and it has been ingeniously attempted to be shown, that a single mountain of sufficient elevation, placed in a favourable situation, and furnished, by the Creative Power, with the various vegetable productions which its different altitudes and consequent varieties of temperature required, might suffice, in the course of ages, for the dissemination of these productions over the whole face of the globe, according as its various localities might be adapted to re-

ceive them. Such an inquiry, however, is more curious than useful. It is enough for us to perceive the designing hand of a wise Creator in the adaptation of the vegetable creation to the very diversified circumstances of soil and climate, as it is found actually to exist in the different countries and regions of the world.

I shall only add, at present, that what has just been said of the vegetable, is equally applicable to the animal kingdom, as will be seen when we enter into the particulars to which these preliminary remarks refer.

THIRD WEEK—SUNDAY.

THE OMNIPRESENCE OF GOD.

THAT the Creator of the universe is every where present throughout His immeasurable creation, and that, if there be any region of infinite space where He has not exerted His creative power, He is there also, seems to be a doctrine involved in the very idea of an eternal, self-existent being; and this doctrine receives a more distinct and definite character, from the discoveries of astronomy. The idea of infinity, indeed, is too vast to be fully comprehended, as any one will be forced to confess who makes the attempt. We can conceive a vast extent, but it is an extent circumscribed by some boundary, however distant; and, if we only attend to what passes in our own minds, when we endeavour to extend our conceptions so as to arrive at the idea of infinite space, we shall find that we do this by figuring to ourselves, first, one immense extent, and then, beyond that, another, and another still, in a constant and indefinite series. This shows the limited nature of our mental powers, which cannot form conceptions, but by the aid of things that are the objects of the senses; and it serves at the same time, to exhibit the importance of astronomical studies, in assisting the mind to form more exalted views of the Divine attributes. Even though deprived of the discoveries of astronomy, indeed, we could still speak of infinity; but our conceptions of that divine attribute would necessarily be far less vivid and definite. It is by the help of this most interesting and astonishing science, that we raise our comprehension from the contracted bounds of our own planet, to the vast extent of the planetary system with which we are connected, and thence to the amazing distances of the fixed stars, and thence again to those little spaces in the heavens called

nebulæ, full of thousands and tens of thousands of worlds, in new systems, at distances beyond the power of numbers to compute. Thus, step by step, we extend our views; and, although, long before we have reached the nearest star, we find our mental powers begin to flag, and, in tracing these discoveries to their farthest limit, are forced to confess that even imagination is bewildered and lost, yet in such an exercise we certainly do gain much to aid our conceptions of unbounded space.

The practical conclusion to which we come is, that, if nature be so unspeakably and inconceivably immense, the God of Nature must be absolutely infinite; and although, after all, we can form no distinct idea of this attribute, we comprehend enough to affect the mind with highly exalted and salutary impressions.

Infinity implies omnipresence. The Almighty is an infinitely extended Mind. Wherever He exists, He is conscious. His knowledge is, therefore, as infinite as His existence. The universe lies open to His inspection. The earth, with all its productions, animate and inanimate,—the rocks and minerals in its bowels,—the plants, so varied in their form and qualities, from the microscopic parasite to the mighty oak of the forest, which are spread profusely over its surface,—the insects, the reptiles, the birds and beasts with which it teems,—and man, the lord of them all, every one of them, individually, is continually in His view. He pervades every atom of matter, and surveys every movement of the living principle, and of the mental powers, with which He has respectively endowed the various orders of organic beings. Let this view be extended to other worlds. Whatever exists, either of matter, of vegetable and animal life, or of rational powers, in the sun and in the planets, and, beyond their wide orbit, in the suns, and systems, and interminable groups of suns and systems of which the universe is composed, is penetrated, beheld, recognized, and individually distinguished, by the All-pervading Mind.

How beautifully and feelingly does the psalmist express the sentiment to which this view of the Divine Being gives rise in the devout heart:—"Whither shall I go from thy spirit? or whither shall I flee from thy presence? If I ascend up into heaven, thou art there; if I make my bed in hell, behold thou art there. If I take the wings of the morning, and dwell in the uttermost parts of the sea, even there shall thy hand lead me, and thy right hand shall hold me. If I say, surely the darkness shall cover me; even the night shall be light about me." This sense of the Divine presence, if deeply and habitually cherished, must produce a salutary effect on the character. When we know and feel that the eye of the holy God is upon us, our mind is struck with solemn awe; and should unhallowed thoughts intrude, we are sensible that they are unworthy of the presence in which we stand, and inconsistent with those aspirations after the Divine favour, which our relation to him inspires. Should the temptation become, notwithstanding, so strong as to incline us to some action of moral turpitude, the half-formed design is checked, by the conviction, that the All-seeing eye is upon us, and with just indignation we cast the thought away from us, inwardly exclaiming, "How can I do this great wickedness, and sin against God."

This salutary effect of a belief in the Divine omnipresence, is but too seldom realized in actual practice. It is held, almost universally, as a speculative doctrine; but how few really adopt it as a rule of life. Melancholy experience assures us, that the heart does not often receive very deep impressions from abstract views, and is not easily awakened and animated by the speculations of the closet. It will be our wisdom to make use of the various means, which Providence has bestowed on us, for counteracting this unhappy propensity to separate speculation from practice; and among these there is none probably so effectual as frequent and fervent prayer. An apostle exhorts us to "pray without ceas-

ing;" by which he doubtless means, not that we should be constantly on our knees, but that we should cultivate a continual sense of the presence of our heavenly Father in the ordinary affairs of life,—and begin, carry on, and end every thing, by casting ourselves on His protection and blessing. By this prayerful spirit, we will learn to see God in every thing. If we walk abroad, whether in the full blaze of day, or when, through the curtain of night, we behold the hosts of heaven shining in their brightness, we will turn our thoughts to that Eternal Being who clothed the earth in beauty, and "ever busy, wheels the rolling spheres." If we retire to the bosom of our families, and in the kind attentions and soothing endearments of domestic life, feel our hearts overflowing with a tender delight, we will not fail to remember from whose hand we derived the blessing, and to whose paternal care we are indebted for its continuance. If, in the duties of active life, we find our labours of love crowned with success, and our bosom expands with the glow of gratified benevolence, we will not forget that it is the hand of our unseen Father, which has directed and blessed our efforts; and a Father's smile, which cheers and elevates our soul. And when the rod of affliction is upon us,—when the loss of worldly possessions oppresses our spirits, or a more cruel calamity has visited us, in the death of some beloved relative or friend; or when we ourselves are stretched upon our death-bed, with our weeping family around us, even then the consolations of religion will lend their balm; and casting our care on Him who careth for us, and finding refuge in the Rock of Ages, we will learn to bless the hand which inflicts the wound.

THIRD WEEK—MONDAY.

ADAPTATION OF ORGANIZED EXISTENCES TO THE TROPICAL REGIONS.

Almost every country has its winter, as well as the other seasons of the year, differing materially, however, in different parts, and influenced not merely by its position in respect of latitude, but by various other circumstances which affect the climate generally,—such as elevation above the level of the sea, the neighbourhood of mountains, of forests, or of the ocean, the prevalence of periodical or constant winds, and other topical causes. Now, the observation which applies to climate, taken on the average, applies with equal truth to this uninviting season, namely, that there is, even during its rigours, a remarkable adaptation of the weather to the condition of animal and vegetable life; and, on the other hand, of animal and vegetable life to the weather. The temperature is admirably modified, and the various meteorological changes are wisely regulated, so as to correspond with the other seasons, and to be suited to the kind of organized existences which are to be found within the range of these natural operations; or, what comes to the same thing, these organized existences have been so framed, as to correspond in their nature and habits with the qualities of the weather.

In tropical climates, there can scarcely be said to be any winter, in the sense in which that word is understood, with reference to the other divisions of the earth; yet, even here, there is a period which possesses some of its distinctive characteristics. Under the equator, indeed, and in the adjoining regions, there may be said to be, in respect of temperature, two winters in the year,—the one, when the sun visits the tropic of Capricorn; and the other, when he looks down on our temperate climes with

the smiles of summer, from the tropic of Cancer. Within the vast zone, bounded by the tropics, the climate is peculiar, not only on account of the extreme heat, but on account of the trade-winds, the monsoons, and periodical droughts by which it is distinguished. These phenomena, which are very various in their periods and extent, being much affected by the particular circumstances of their geographical position, wonderfully harmonize during the various seasons of the year, so as to render them, in each region, speaking generally, conducive to the salubrity of the climate; and the plants and animals which exist in these regions, are, at the same time, with surprising care, adapted to their respective peculiarities. This, would our space admit, might be interestingly exemplified by a detail of particulars; but, at present, I must be content to state, in general, that there are contrivances and adaptations which secure both plants and animals from the hurtful effects of the changes of temperature, of moisture, of violent and incessant rain, and of the direct rays of the sun, so striking and obvious, as to challenge attention from the most careless observer. In this fervid climate, the soil requires no lengthened rest to recruit its powers; nor do its vegetable products need to sleep for months in the bud or in the root. Under a long drought, indeed, they languish and decay; and this may, in fact, be considered as their period of winter, although it does not correspond with ours as regards the season of the year, or various other particulars; but no sooner does the equinoctial monsoon or the solstitial rain pour its refreshing streams on the surface of the parched earth, than all nature revives. Mr Elphinstone, in his account of Cabul, after graphically describing the appearances at the commencement of the monsoon in India, consisting of an incessant pouring of rain, amidst constant peals of thunder, and the most vivid flashes of lightning, attended with violent blasts of wind, proceeds to say,—"This lasts for some days, after which the sky clears, and discovers the face of nature

changed as by enchantment. Before the storm, the fields were parched up; and, except in the beds of the rivers, scarce a blade of vegetation was to be seen; the clearness of the sky was not interrupted by a single cloud, but the atmosphere was loaded with dust, which was sufficient to render distant objects dim as in a mist, and to make the sun appear dull and discoloured till he attained a considerable elevation; a parching wind blew like a blast from a furnace, and heated wood, iron, and every solid material, even in the shade; and immediately before the monsoon, this wind had been succeeded by still more sultry calms. But when the first violence of the storm is over, the whole earth is covered with a sudden but luxuriant verdure; the rivers are full and tranquil; the air is pure and delicious; the sky is varied, and embellished with clouds."

This change, from what may be called a tropical winter, though arising from an excess of heat instead of cold, to all the beauty and luxuriance of spring, proves, without any detail, that a constitution has been given to tropical plants, adapted to their situation and circumstances, and sufficiently marks the peculiar wisdom of the arrangement as regards the vegetable kingdom. Let it be remarked, too, that the monsoon takes place precisely at the very time when, but for this change, the heat would have become excessive and intolerable. It occurs at the period when the sun is approaching his zenith in that parallel, and would have darted his vertical rays on the earth with unmitigated fierceness, were not a providential hand to interpose a veil of clouds, and cause them to pour forth their refreshing stores. This change is not the less admirable, that it is produced by the operation of known and uniform laws; and, assuredly, the wise adjustment and balancing of the great mechanical powers of nature is no unequivocal proof of Divine agency.

On turning to the animal productions within the tropics, we discover similar marks of beneficent design in

the adaptation of their natures to the circumstances of the climate. M. Lacordaire,* as quoted by Mr Kirby, gives a striking account of the state of animated nature in Brazil. The great rains begin to fall in that country about the middle of September, when all nature seems to awake from its periodical repose; vegetation resumes a more lively tint; the greater part of plants renew their leaves; and the insects begin to appear. In October the rains are rather more frequent, and with them the insects; but it is not till toward the middle of November, when the rainy season is definitively set in, that all the families seem suddenly to develope themselves; and this general impulse, which all nature seems to receive, continues augmenting till the middle of January, when it attains its acmè. The forests present, then, an aspect of movement and life, of which our woods in Europe can give no idea. During part of the day we hear a vast and uninterrupted hum, in which the deafening cry of the treehopper prevails, and you cannot take a stép, or touch a leaf, without putting insects to flight. At eleven in the forenoon, the heat has become almost insupportable, and all animated nature becomes torpid; the noise diminishes; the insects and other animals disappear, and are seen no more till the evening. Then, when the atmosphere is again cool, to the morning species succeed others, whose office it is to embellish the nights of the torrid zone. I am speaking of the glow-worms and fire-flies; whilst the former, issuing by myriads from their retreats, overspread the plants and shrubs,—the latter, crossing each other in all directions, weave in the air, as it were, a luminous web, the light of which they diminish or augment at pleasure. This brilliant illumination only ceases when the night gives place to the day.†

These observations as to the effects of climate within the tropics, harmonizing as they do with what occurs in

* Annales des Sciences Naturelles, 20 Juin 1830, p. 193.

† Kirby's Bridgewater Treatise, vol. ii. pp. 250-1.

other regions of the earth, tend to show what surprising attention has been paid by the great Creator, in the adaptation of organized existences, both vegetable and animal, and more especially the latter, with its instincts and habits, to their geographical position, and what skill has been employed in diffusing life and enjoyment throughout the world. Facts of a similar kind will meet us every where in the course of our inquiry.

THIRD WEEK—TUESDAY.

ADAPTATION OF ORGANIZED EXISTENCES TO TEMPERATE AND POLAR CLIMATES.

Our attention was yesterday directed to those beneficent arrangements by which organized existences, within the tropics, are adapted to their geographical position. The same observation may be extended to all the other regions of the earth, and the farther the subject is investigated, the more shall we find reason to admire and adore the Divine wisdom, so variously, and every where so beneficently displayed.

Among a vast profusion of instances which might be selected, I will take the history of the camel, which recommends itself to our notice at present, as being peculiarly appropriate, in our descent to climates of a lower temperature, because the range of this animal is extended from the tropical into the temperate regions; and because, within that range, its conformation and habits are curiously and exclusively suited to a peculiar locality. The camel, including, of course, the dromedary, which is only a variety of the species, is an animal distinctly formed by the Author of Nature, to subsist, and to contribute to the comfort of man, in the parched and sandy wildernesses, which, in the vast regions of the east, stretch from the tropics far into the temperate zone.

A description, abridged from Goldsmith, may suffice for our purpose.

The camel is the most temperate of all animals, and it can continue to travel for several days without drinking. In those vast deserts, where the earth is very dry and sandy; where there are neither birds nor beasts, neither insects nor vegetables; where nothing is to be seen but hills of sand, and heaps of stones; there the camel travels, posting forward, without requiring either drink or pasture, and is often found six or seven days without any sustenance whatever. Its feet are formed for travelling on sand, and are utterly unfit for moist or marshy places.

In Arabia, and those countries where the camel is turned to useful purposes, it is considered as a sacred animal, without whose help the natives could neither subsist, traffic, nor travel. Its milk makes a part of their nourishment; they feed upon its flesh, particularly when young; they clothe themselves with its hair; and, if they fear an invading enemy, their camels serve them in flight; and, in a single day, they are known to travel a hundred miles. Thus, by means of the camel, an Arabian finds safety in his deserts. All the armies on earth might be lost in pursuit of a flying squadron of this country, mounted on their camels, and taking refuge in solitudes, where nothing interposes to stop their flight, or to force them to await the invader. There are here and there found spots of verdure, in the dreary wastes inhabited by the Arabian, which, though remote from each other, are, in a manner, approximated by the labour and industry of the camel. Thus the Arab lives independent and tranquil amidst his solitudes; and, instead of considering the vast wilds spread around him as a restraint upon his happiness, he is, by experience, taught to regard them as the ramparts of his freedom. Who does not admire in this remarkable instance, the beneficent intentions of Providence, in the structure and habits of an animal so exclusively adapted to regions of heat, sterility, and drought?

In the temperate regions, similar adaptations to the season of scarcity are familiar to the student of nature; but, as it is in this zone of moderate climate that we dwell, and from it, therefore, that our illustrations will, in the following pages, be chiefly taken, I shall pass to its extreme verge, toward the polar circles, where the countries, although they still bear the geographical title of temperate, have ceased, in reality, to deserve it, and are rapidly tending to an extreme, in which organized beings are no longer to be found. The Laplander, the Greenlander, the inhabitants of Nova Zembla and Labrador, although, in winter, they suffer many privations, greater than are experienced in our more favoured climate, are yet furnished with many alleviations, which prove that their comfort and enjoyments, have not been forgotten by Him who appointed the bounds of their habitation.

Some inhabitants of these severe regions have received from a bountiful Providence the gift of the rein-deer, which is not less adapted to their wants than the camel is to those of the Arab. It furnishes them with the means of rapid and easy conveyance from place to place; while its skin supplies them with clothing for their bodies, and covering for their tents, its flesh is their necessary food, and its milk their delicious drink. Their long winter night, for it is one uninterrupted night during several months, is cheered by a bright twilight, and the brilliant and busy coruscations of that wonderful meteor, the aurora borealis; and, when they retire to their humble dwellings, they find at once light and heat in the blaze of the oil abundantly extracted from the fish which their industry has drawn from the neighbouring seas.

In Greenland, and the countries bordering on Baffin's Bay, where the rein-deer is but seldom, if at all, domesticated, the inhabitants have other means of supplying, though less comfortably, the necessaries of life, which this useful animal provides to the northern inhabitants of Europe They build their winter huts of *snow*, within which they light their fires, without danger of its melt-

ing, so long as the intensity of the cold remains; and, within these apparently miserable habitations, they experience more enjoyment than the natives of more genial climes can easily conceive possible. The frost preserves from corruption the animal food they have stored; and, so long as their provisions remain, care and distress scarcely find access to their minds. Having few wants, and little forethought, they spend, from day to day, a contented, though a degraded life; and the goodness of the great Creator towards them, appears in this, that if their circumstances preclude them from the enjoyment of many luxuries, or even conveniences, they are happily insensible of the privation; and, if they are destitute of high intellectual pleasures, they are at least not subjected to the miseries arising from that acute sensibility with which the cultivation of the mental powers is frequently attended.

Were we to inquire into the condition and habits of the lower animals which inhabit these frozen regions, we should be struck with similar wise adaptations. Of the thick and shaggy fur which covers their bodies, so admirably adapted both to preserve the animal heat, and exclude the external cold, increasing in warmth with the increasing rigour of the season; of the instinct which induces some to emigrate to more genial regions, and others to retire to caves and burrows, where they spend the long and dreary winter months in a state of insensibility, or of partial lethargy; and of other matters connected with the season of winter in that inhospitable climate, which indicate, even in that apparently neglected corner of the world, unequivocal proofs of beneficent design, we shall afterward have occasion to speak. Meanwhile, this slight sketch seems sufficient to show, that, in every climate, even the dreariest season of the year has its uses, its adaptations, and its enjoyments.

THIRD WEEK.—WEDNESDAY.

THE BALANCE PRESERVED IN THE ANIMAL AND VEGETABLE CREATION.

Every naturalist must have observed, that there is a tendency in the reproductive powers bestowed by the Creator, to overstock the world, so that, if any one species of animals were permitted to produce its kind without check, the whole earth would, in process of time, be entirely over-run by that species alone, to such an extent, that, by-and-by, there would not be room for the vegetable to spread, or the animal to move. Among living creatures, a remarkable example of this power may be taken from the rabbit. This animal breeds seven times in a year, and produces from four to eight young ones each time. On the supposition, therefore, that this happens regularly, at the end of four years, a couple of rabbits would have peopled the land with a progeny of nearly a million and a half. The common grass is an example of a similar kind among vegetables, a single plant of which would, in a very few years, under favourable circumstances, clothe a whole island such as ours. These are extreme cases; but, if any person would take the trouble of estimating the productive powers of any one kind of plant or animal, even the least remarkable for fecundity, he would soon satisfy himself, that the fact is not overstated.

This excessive power of reproduction, as in one sense it may be called, seems to be a necessary part of the wise economy of Nature; because it always enables organized existences to propagate their species, up to the extent in which provision is made for their subsistence; but then it would have occasioned the most injurious consequences, were not checks provided, by which each kind might be kept within its proper bounds. These checks

are numerous and effectual. The most remarkable of them, among the living tribes, is the existence of predacious animals. One creature preys upon another, and thus provision is made, by a remarkable contrivance, which, at first sight, appears cruel, for the existence of more numerous species, and for the more easy death of individuals, which would otherwise so press upon the means of subsistence, as to drag out a lingering and miserable life, till they perished by famine; while another instance of providential care in this provision is, that dead bodies are consumed and removed, which would otherwise infest the air with noisome and pestilential effluvia, in the process of decomposition.

But what has led me at present to advert to this subject, is the effect which winter also produces in checking an over production of organized beings. To what extent its severity, and the scanty subsistence it affords, are destructive of animal and vegetable life, I shall not attempt to estimate; but that it is considerable, cannot be denied. Notwithstanding the various and astonishing means made use of by a wise Creator, for the preservation of organized beings during the inclemency of winter, it is certainly true, that this season does not pass without a great expense of life. Violent storms, severe frosts, sudden inundations, deep snows, scarcity of food, the tracks of animals in the new-fallen snow, which guide the hunter to their lair,—all these are so many means of destruction to numerous individuals of various tribes of animals, and some of them means of destruction to different kinds of vegetables also.

Now, that the checks we have mentioned, combined with others, are most wisely adapted for promoting the benevolent intentions of Providence, in preserving a due balance in Nature, may be inferred from various considerations. Of these, I shall mention one, which is sufficiently striking. Man has frequently attempted, for his own purposes, to interfere with the balance which Providence has thus established, often wisely and suc-

cessfully, the higher species being destined to supplant the lower; but when injudiciously, not with impunity. The following examples of the latter, which I extract from a note in Mr Sharon Turner's History of the Creation, may suffice as an illustration. "Farmers destroy moles, because the hillocks they make break the level surface; but they have found worms increase so much, when the moles were gone, as to wish they had not molested them. Moles live on worms, insects, snails, frogs, and larvæ. The farmers on a nobleman's estate in France, found the moles' disturbances of the earth such a good husbandry to it, as to solicit their landlords not to have them killed.—(Bull. Un., 1829, p. 334.) So toads are found to keep down the ants. Mice have increased in barns where owls have been shot. The blue jay was destroyed in America for eating the pease; but the pea-grub, which it fed on, became more destructive afterward. A gentleman shot a magpie, to save his cherries, but found its craw as full as it could be crammed with the large blue-bottle flies, that lay their eggs in meat. The fox renders considerable service to man, by the quantity of rats, field-mice, frogs, toads, lizards, and snakes, which he destroys."*

These are instances of the kind of balance which is preserved in the animal world, by means of predacious animals, and prove that, by removing one cause of annoyance, we may sometimes only give room to another of a more grievous nature; and that we ought, therefore, to be cautious how we do violence to Nature. There can be no doubt, however, that the judicious interference of man was taken into account in the establishment of the order of Nature; and that his employing his rational powers for this purpose, is one of the exercises by which Providence intended to call forth his ingenuity, and reward his industry. It is not merely as a curse, that, in the field of the sluggard, "thistles grow instead of wheat, and cockle instead of barley;"—it is also as a warning

* Turner, note, p. 350, quoting from Howit's Brit. Preserv.

against sloth, and as a stimulus to exertion. So it is with regard to industrious, intelligent, and virtuous habits of every kind; and, with reference to the agriculturalist, while the neglect of such habits is punished by an accumulation of noxious weeds and vermin, and a deficiency of useful produce, the very reverse is the case when these are cultivated;—and, *mutatis mutandis*, the same observation may be made in relation to every other profession.

Of the salutary effect of a judicious use of the power which Providence has entrusted us with, of extirpating noxious animals, we have a remarkable instance in the total extinction of the wolf from Great Britain, chiefly through the energetic measures adopted by two of our kings, Edgar I. and Edward I. The importance which we ought to attach to the removal of this nuisance, will be better estimated on reading the official account which was given in the public papers, of the devastations committed by wolves, in the year 1823, in the province of Livonia alone. They are stated to have devoured 1841 horses, 1243 foals, 1807 horned cattle, 733 calves, 15,182 sheep, 726 lambs, 2545 goats, 183 kids, 4190 swine, 312 sucking pigs, 703 dogs, 673 geese.

This destruction is remarkable, and it is only a single example of the immense extent of the power by which the excess of the reproductive principle is restrained, in all the various races of living beings, from the microscopic insect to the huge elephant. The proof thus afforded of the wisdom of the great Creator, is conspicuous and pre-eminent; the balance of Nature is preserved; one species, taken on the average, does not unduly encroach upon another; a greater quantity of living beings has the means of being nourished, and is therefore produced; and the good of the whole is most strikingly consulted.

One condition, which the due balance of the reproductive powers involves, is, that the most useful species shall be able not only to maintain their ground, but to preponderate over all the rest. This is instanced in the

case of vegetables, in the prolific power already noticed, as bestowed upon the common grasses on which so many animals, and especially those destined for the use of man, are formed to feed. It is in virtue of this quality, with which man, for his own purposes, finds it necessary frequently to war, that the soft green carpet is so universally spread over hill and valley, on which our herds and flocks browse so luxuriously by day, and repose so comfortably by night. But then, it was the wise intention of Providence, that this mastery, gained by the prolific power, should not be of such extent as to annihilate any of the species of plants formed by His creative wisdom. There are, therefore, most surprising and ingenious contrivances, by which this power is so far counteracted as to serve the end in view. These will fall more properly to be considered in another season, and it is enough at present merely to advert to them.

In saying, however, that the most useful vegetable productions are usually the most prolific, I must not forget to make an exception, which embraces a great variety of those plants that are cultivated by the farmer and the gardener, for the use of man. All the cereal, leguminous, potato, and cabbage tribes are of this kind, and seem to be intended, along with many other means in the economy of Providence, to verify the sentence so early pronounced on our fallen race, that in the sweat of their brow they must eat bread. It is, indeed, in this view, a most remarkable provision, that while the means of subsistence is so amply provided for the lower animals, man is left to procure his food by the exercise of his own mental and bodily powers, in the labours of cultivation; and, for this purpose, finds it necessary to counteract the natural tendencies of vegetation, as well as to control the habits, and subdue the propensities of the brute creation.

Among animals, the balance which we have been considering is kept up in a way different from that which takes place in the vegetable kingdom, though in some

respects analogous to it. Here, too, the powers of reproduction are with obvious design unequally distributed, being most copiously bestowed on those species which are either most useful to man, or most harmless in their own nature, or least capable of defending themselves. Were not this the case, animals of prey, whose species are numerous, and are to be found in all the classes of animated nature, from the lowest to the highest, would soon destroy the more helpless kinds, and reduce the various orders of beings to a few of nearly equal strength and prowess in the various genera. Among beasts, the lion and tiger, for example, would desolate the tropical regions; the wolf would reign paramount in the temperate zone; and the arctic bear would over-run the regions bordering on the poles, till nothing would be left for them to devour but creatures of their own species. Among birds, the eagle, the vulture, and the condor, would each assert the terrible powers of its nature, till the other feathered tribes, in their respective localities, had been exterminated; and as to fishes, the enormous whale,* and the rapacious shark, each of which devour the inferior tribes by hundreds at a mouthful, would quickly divide the desolated ocean between them.

The very fact, therefore, that, notwithstanding the existence of such formidable enemies, the other tribes of animated beings not only survive but abound, is a proof that the Author of Nature has provided sufficient checks to their power and rapacity. Of quadrupeds alone, from 800 to 1000 species are known to exist; and, as we descend in the scale to the lower genera, their species proportionally increase, till among the insect and microscopic tribes, they become almost innumerable. If this be the case with regard to species, how would the mind be overwhelmed with the immensity of the subject, were it to attempt to estimate the number of individual existences in the animal and vegetable kingdoms. Let us re-

* The Greenland whale is supposed to live only on medusæ or shrimps, but the catchalot, and its varieties, are exceedingly voracious.

cognize and admire the designing mind which has with such wonderful skill adjusted the balance of nature, and fitted it to the condition of man in his fallen state. It is impossible not to be struck with the analogy which runs through all the departments of organized existence, from the highest to the lowest, in this as well as in other instances. We see every where a superabundant power of reproduction counteracted and balanced by what may be justly called antagonist powers. Among these opposing forces we find voracity and famine every where, excessive heat and periodical storms in tropical countries, excessive cold during the winter of the temperate and frigid regions, each in its own manner and its own place, doing the necessary work of destruction.

THIRD WEEK—THURSDAY.

ALTERNATION OF DAY AND NIGHT.

With us the sun now remains little more than eight hours above the horizon; and, even during that short period, the comparative intensity of his light and heat is much decreased. He is daily taking a less extensive circuit in the heavens; and in another month the length of the day will be diminished by more than another hour. Were the influence of the sun, and the length of the day to continue in this state, the whole organized world, in the climate which we inhabit, would quickly be destroyed. But the year will soon recommence its annual round; and nature is even now preparing for its coming labours.

The repose of plants, and even of many animals, in this dreary season, reminds us of the salutary provision, of a similar nature, which is made for the diurnal recruiting of exhausted strength by the alternation of night with day. That this arrangement is adapted to the constitution of animal and vegetable existences, will

be readily admitted; and, on examining particulars, we shall be confirmed in our general conclusion. It is not merely true that nature requires a frequently recurring period of rest, but that the actual period of twenty-four hours, divided between activity and repose, is the best suited for this end. If this be so, it implies a Designing Cause; for such a period is *arbitrary;* that is to say, no reason can be assigned, in the nature of things, either why the earth should complete her daily revolution in twenty-four hours, or why animals and vegetables should require a season of rest in that precise interval. As to the former, no mechanical or physical necessity requires that our earth should complete three hundred and sixty-five revolutions in a year. She might, apparently, either move faster or slower, without the slightest inconvenience to the system with which she is connected. Jupiter and Saturn revolve on their axes each in ten hours, which, considering their bulk, must carry their equators round with a velocity immensely greater than that of the earth, while Mercury, which is so much nearer the sun, and so much smaller, has its day and night nearly of the same length as our own.

Now, if we look at the vegetable world, we shall find, as already observed, a remarkable adaptation of this arbitrary period of twenty-four hours to the constitution of its various productions. In some plants, indeed, this is not so obvious; but there are others which clearly show that they are endowed with a periodical character, corresponding with the average length of our day. Linnæus classified a number of plants according to their time of opening and shutting, with reference to the hour of the day, and found that there are some which change their hour of opening and shutting as the day becomes longer or shorter, while there are others which do not seem to be affected by the actual state of the light and heat, but have a daily period of their own, independent of these influences, expanding their leaves, and closing them, at a particular hour, whatever be the state of the

weather, or the length of the day. Both of these instances prove an adaptation to the diurnal revolution of the earth, which could not be the effect of chance, and must, therefore, have been the work of an Intelligent Cause.

This adjustment is still more remarkable in the animal world. A period of sleep is necessary for the health and vigour of living beings; and the alternation of day and night, which actually takes place, seems, from various considerations, to be that which is best fitted for them; or, at all events, any very great deviation from the arrangement actually established, would be prejudicial. When a workman retires from his twelve hours' labour, he is sufficiently inclined to take rest; and, although it is possible for him to encroach on the night, without much inconvenience, and to extend his exertions, if not immoderate, to fifteen or sixteen hours, a longer period, without an interval of repose, would incur the risk of undermining the constitution. It is certain, at least, that a considerable proportion of time, spent in sleep during the four and twenty hours, is of importance to the health both of body and mind; and that, if our day were extended, for example, to the length of two, the human powers would droop under the prolonged period which would thus occur between the intervals of rest.

To the lower animals also, the alternation of day and night, as it actually exists, is wisely adapted. To some of these, the day is the season of collecting their food; to others, the night: but, whatever be the instincts which guide them in this respect, we cannot but perceive that the adjustment between their constitution and habits, on the one hand, and the period of light and darkness, on the other, is such as to show that the one bears reference to the other, and to indicate benevolent contrivance.

It is no valid objection to this view, that the relative length of the days and nights vary very considerably in our climate, and still more in higher latitudes; because, where this is the case, we find adaptations and adjust-

ments of a different kind, which, in some degree, compensate for these variations; and because, except in regions approaching very near the poles, the revolution of day and night is uniformly comprised in twenty-four hours; and the only difference consists in a longer or shorter time during which the curtains of night are drawn—an inconvenience which the ingenuity of man removes by artificial means, and to which the habits and wants of the lower animals, and of plants, are wonderfully accommodated.

On the whole, we have here another proof of an Intelligent Creator, who has suited the organized beings he has called into existence, to the circumstances of the material world, in which he has been pleased to place them. The observations of Mr Whewell, on this subject, to whose judicious statements we have so frequently had occasion to refer, are entirely to the purpose. "The hours of food and repose," says he, "are capable of such wide modifications, in animals, and, above all, in man, by the influence of external stimulants and internal emotions, that it is not easy to distinguish what portion of the tendency to such alternations depends on original constitution. Yet no one can doubt that the inclination of food and sleep is periodical, or can maintain with any plausibility, that the period may be lengthened or shortened without limit. We may be tolerably certain that a constantly recurring period of forty-eight hours, would be too long for one day of employment, and one period of sleep, with our present faculties; and all, whose bodies and minds are tolerably active, will probably agree, that, independently of habit, a perpetual alternation of eight hours up, and four in bed, would employ the human powers less advantageously and agreeably, than an alternation of sixteen and eight. A creature which could employ the full energies of his body and mind uninterruptedly for nine months, and then take a single sleep of three months, would not be a man."

"This view," he afterward adds, "agrees with the

opinion of some of the most eminent physiologists. Thus Cabanis notices the periodical and isochronous character of the desire to sleep, as well as of other appetites. He states also, that sleep is more easy and more salutary, in proportion as we go to rest, and rise every day at the same hour; and observes, that this periodicity seems to have a reference to the motions of the solar system."

All this leads to the conclusion, that the correspondence thus obvious between the laws of the material world, and the constitution of man, and other animals, is not fortuitous, but is the appointment of a Wise Contriver, and manifests a designing First Cause.

THIRD WEEK.—FRIDAY.

SLEEP.

We have already taken notice of the dormant state of some animals, and even plants, in winter, as an instance of wise and beneficent design; but there is another state of somnolency, more frequent in its occurrence, and more limited in its duration, to which I shall now direct the attention of my readers; I mean that condition of the body to which we familiarly give the name of Sleep.

The remarkable manner in which the constitution of plants and animals is adapted to the length of the day, was yesterday commented on; and one of the most striking of these adaptations is the provision by which man, and many of the lower animals, drop into a state of inactivity and sweet oblivion during the night.

The presence of light is necessary to enable creatures, constituted as we are, to prosecute useful labours; but constant toil wears out the frame, and a period of rest is necessary. There is, therefore, an arrangement of our ever-provident Creator, by which light shall be, for a time, withdrawn from us, that we may be compelled, by

a natural necessity, to refrain, at regulated and short intervals, from the prosecution of labours in which we might otherwise be too eagerly engaged. This is the point of view in which the subject has been already considered. Let us now attend to the subject in another light. Looking at the fact, that the earth is made to revolve on its axis once every twenty-four hours, and that thus its inhabitants are deprived of its light, and other genial influences, for nearly the half of that time, on an average, each day, What is the contrivance by which this natural occurrence is rendered agreeable and salutary? The reply is, that a provision is made by which the active powers both of body and mind are suspended, and sleep is induced.

And what is sleep? There is something very mysterious in this state, considered as a physiological phenomenon; but this inquiry does not fall under our present plan; and, if it did, we should probably find it difficult to come to any satisfactory conclusion as to its efficient cause, or the nature of the physical change in the nervous system, by which it is produced. We know it is a fact in the constitution of living beings; and this is all that it seems necessary, at present, to say on the subject. To define sleep, according to its actual appearances, is sufficiently easy. In attending to our own experience, in regard to its approach and actual occurrence, we discover that the will seems gradually to become enfeebled in its power over both the bodily and mental operations; that the body becomes as it were benumbed, and ceases to receive impressions of external objects; and that the faculty of thought seems to wander without control. In the functions which serve for the support of life, on the contrary, there is no material interruption. All of them remain unsuspended, and some of them are maintained in full vigour and activity. The natural actions of respiration, circulation, and digestion, are little affected. The powers, which are merely mechanical or chemical, seem to proceed in the usual manner; and, what-

ever internal *stimuli* are necessary for keeping them in action, retain their sensibility.* It is otherwise with the different senses. These fall into a state of obtuseness and relaxation, from which they are not easily roused, though the possibility of affecting them, even without putting an end to the state of sleep, is a matter of daily experience; and, indeed, the fact that a sleeper can be awaked at all, through the medium of his sense of hearing, or of touch, or of sight, or even of taste or smell, is a sufficient proof that these faculties are not completely suspended. Neither is there a suspension of the mental powers. Our thoughts succeed each other with inconceivable rapidity, and the imagination appears often to be peculiarly awake and brilliant. It is the power of volition alone, so far as the mind is concerned, which has ceased to be exerted. This is usually attended with a relaxation of the voluntary muscles, which occasions a total want of power in all the parts of the body over which these muscles have control. I mention this, however, only as the *usual* condition of persons in a state of somnolency; for it is one of the remarkable phenomena of dreaming, to which we shall have occasion afterward to advert, that the mind does then frequently exert an influence, of a very extraordinary nature, over the bodily functions.

There is something at once interesting and strange in this state, which its familiar occurrence causes us too often to lose sight of; but I must at present confine myself to a single observation. It is an essential characteristic of sleep, that, so far from being able to induce it

* It seems that this should be taken with some limitation. "Sleep," says Mr Macnish, "produces rather important changes in the system. The rapidity of the circulation is diminished, and, as a natural consequence, that of respiration: the force of neither function, however, is impaired; but, on the contrary, rather increased. Vascular action is diminished in the brain and organs of volition; while digestion and absorption all proceed with increased energy." "Sleep lessens all the secretions, with one exception,—that of the skin." "Sleep produces peculiar effects on the organs of vision. On opening the eyelids cautiously, the pupil is seen to be contracted; it then quivers with an irregular motion, as if disposed to dilate; but at length ceases to move, and remains in a contracted state till the person awakes."

when we please, the anxiety to obtain this refreshment only drives it away from us; and it is not till we cease to think about it, that it steals on us. This is doubtless a wise provision; but then, were it to invade our body and mind not only unsolicited, but unexpected, and were we unable, to any extent, to counteract its approaches, very distressing effects might be produced. Attend to this for a moment. If we were to drop asleep, without warning, in the midst of some active operation, it is easy to see how many daily occurrences, of the most disastrous nature, would ensue. Struck by the unexpected visitant, the seaman, as he ascended the top-mast, or clung on the yard-arm, would relax his grasp, and be plunged into the sea, or dashed to pieces on the deck. The coachman, in the middle of his stage, would drop his reins, and fall senseless from his box. The builder would tumble with his trowel from the wall. The porter would fall paralyzed under his burden. The orator in the senate, at the bar, or in the pulpit, would falter, and sink with the unfinished sentence on his lips; and, in one, the fire of his patriotism; in another, the acuteness of his reasoning, or adroitness of his statement; and, in a third, an exhibition of the high and holy doctrines of the Gospel, or of impassioned eloquence in a heart full of zeal, or of the tender touches of Christian love, would ludicrously expire in a sudden drawl, a closing eye, and a countenance in an instant relaxed into an expression of drowsy insensibility. Or rather, almost all these active and useful operations, and indeed most of the important business of life, would be prevented by the anticipation of so inconvenient and dangerous a catastrophe.

It is, therefore, no slight proof of the wisdom of the Divine Contriver, that, while he has rendered sleep a necessary function, superior to the human will, he has, at the same time, afforded such indications of its approach, as to allow man time and opportunity decently to compose his limbs, and has even bestowed upon him such power of temporary counteraction, especially in seasons

of active exertion, as to enable him to carry on his operations for a considerable period, without serious inconvenience, or fear of interruption, by the unwelcome and deathlike intruder.

THIRD WEEK—SATURDAY.

DREAMING.

The phenomena of dreaming, which are so remarkable, and in some respects so inexplicable, seem to have been afforded by Providence, as a kind of agreeable relaxation to the ever active powers of the mind, while the bodily functions are in a state of necessary repose.

The subject has attracted deep attention from the earliest times, and has given rise to views and theories of very different kinds, corresponding either with the prepossessions of a particular age, or with the speculative views of the individuals by whom it has been treated. In early times, when a miraculous intercourse was kept up between heaven and earth, in preparing the world for the reception of the Saviour, dreams were frequently employed as the medium of that intercourse; and it was perhaps owing to these *real* events, that a superstitious veneration for dreams was cherished, even in the most polished ages of the ancient world. The Greeks and Romans divided the action of the mind, in sleep, into five sorts,—the dream, the vision, the oracle, the *insomnium*, and the phantasm, of which the three first were supposed to be divinely inspired. To such height had the superstitious feeling with regard to dreams arisen in Rome, in the age of Augustus Cæsar, that this monarch procured the passing of a law, obliging all who had dreamed any thing respecting the state, to make it publicly known; and he himself, in consequence of a nocturnal vision, submitted to the degrading act of begging in the streets.

More rational views have of late been entertained on this curious subject, though the philosophical theories which have been entertained regarding it, are still far from being either very satisfactory in themselves, or consistent with each other. On these I shall not enter;* but some facts present themselves to our notice, which seem worthy of remark.

What I have chiefly to observe is, that, whatever may have been the design of Providence in appointing the existence of this mysterious state of mind, its functions are so guarded and qualified, as, speaking generally, to prevent injurious consequences, and often to afford an exhilarating play to the imagination. The dreamer is introduced into a kind of fairy land, where, as Addison, with his usual elegance and felicity, expresses it, "the soul converses with numberless beings of her own creation, and is transported into ten thousand scenes of her own raising: she is herself the theatre, the actor, and the beholder." In this state, when reason appears, for a time, to have given up the reins to fancy, it seems as if a very slight variation in the intensity of the feeling, or in the duration of the delusion, might be attended with fatal effects. Sometimes a deed of horror is supposed to be done, or the most overwhelming calamity is believed to have happened. The event is depicted in the strongest colours; it is actually seen, as it were, to take place before our eyes; the impression made on the mind is

* Should the reader wish to prosecute this subject, he may be referred to the interesting observations of Dr Abercrombie, in his "Inquiries concerning the Intellectual Powers," and to the elaborate work of Mr Robert Macnish of Glasgow, on "The Philosophy of Sleep," where the phenomena of sleep and dreaming are investigated with much ingenuity, and in a manner which has deservedly gained the author considerable celebrity. Dr Abercrombie states, that there is a strange analogy between dreaming and insanity; and he defines the difference between the two states to be, that, in the latter, the erroneous impression being permanent, affects the conduct; whereas, in dreaming, no influence on the conduct is produced, because the vision is dissipated on awaking. "This definition," says Mr Macnish, "is nearly, but not wholly, correct; for, in somnambulism and sleep-talking, the conduct is influenced by the prevailing dream. Dr Rush has, with great shrewdness, remarked, that a dream may be considered as a transient paroxysm of delirium, and delirium as a permanent dream."

that of assured conviction of its truth, accompanied with the most intense agony; a moment longer, and the brain would be set on fire. That boundary, however, is never passed. A provision is made by which the very violence of the agitation effects the remedy, and the dreamer awakes with a heart ready to burst indeed, or with nerves strung and shaken to the very verge of their utmost endurance; but the phantoms disappear, the anguish subsides; and, in a few minutes, the mind is as calm and serene as before.

The same observation will apply, with still greater force, to the phenomena of somnambulism, the most frightful and dangerous condition of persons in sleep. This is evidently not a natural and healthy, but a diseased state of the bodily and mental powers, and therefore forms such an exception to the general rule as we would make in any other case of morbid action. It is worthy of remark, however, that while this irregular affection shows the distressing consequences which might ensue, were it to be the usual accompaniment of the dormant state, and thus very strikingly proves the wisdom of the natural provision, the law of which is, that the body shall not obey the dictates of the soul in sleep, it is at the same time kept within such bounds, that fatal, or even distressing accidents, seldom take place from the vagaries of the somnambulist. We hear of such persons climbing to the tops of houses, or walking along precipices, and performing other perilous feats, which in their waking hours they would have shuddered even to think of, yet, when left undisturbed, with astonishing dexterity surmounting every danger, and returning in safety to their beds, thus affording a pleasing conviction that He who permits the occasional irregularity, has condescended with paternal care to mitigate its unhappy effects. But we must further remark, that even these are extreme and very rare instances, and that, in by far the greatest variety of cases, in which there is a tendency to this disease, the body only very partially and very harm-

lessly yields to the suggestions of the mind. A few muttered sentences, or a restless turning in bed, or at most, perhaps, a habit of occasionally rising and walking about the floor, are in general the only indications that the body has a tendency, under the excitement of dreaming, to obey the suggestions of the imagination.

Having mentioned the subject of somnambulism, I am reminded of a remarkable instance of it, recorded in the Edinburgh Encyclopedia, in its memoir of my venerable relative, Dr Blacklock, whose accomplishments as a poet and a clergyman, though struggling from his early infancy with all the privations of blindness, are so well known to the literary world. This excellent man had received a presentation to the living of Kirkcudbright, and his settlement was violently opposed. He was deeply agitated with the hostility which was manifested against him, and after dining with some friends on the day of his ordination, finding rest necessary to recruit his harassed and exhausted spirits, he left the table and retired to bed, when the following extraordinary circumstance occurred :—" One of his companions, uneasy at his absence from the company, went into his bedroom a few hours afterward, and finding him, as he supposed, awake, prevailed on him to return again into the dining-room. When he entered the room, two of his acquaintances were engaged in singing, and he joined in the concert, modulating his voice as usual with taste and elegance, without missing a note or a syllable ; and, after the words of the song were ended, he continued to sing, adding an *extempore* verse, which appeared to the company full of beauty, and quite in the spirit of the original. He then went to supper, and drank a glass or two of wine. His friends, however, observed him to be occasionally absent and inattentive. By-and-by he was heard speaking to himself, but in so slow and confused a manner as to be unintelligible. At last, being pretty forcibly roused by Mrs Blacklock, who began to be alarmed for his intellects, he awoke with a sudden start,

unconscious of all that had happened, having been the whole time fast asleep."*

Lord Brougham, in his preliminary discourse to the edition of Paley's Natural Philosophy, lately published,† makes use of the phenomena of dreaming, as an argument for the mind's independence of matter, and capacity of existence without it. His argument, in a few words, is this:—In the state of dreaming, all the bodily functions which depend upon volition are suspended; and the bodily senses, though not entirely in a state of abeyance, become very obtuse. But this does not interrupt the activity of the mind; on the contrary, the power of imagination, and the celerity with which ideas pass through the mind, are increased by this cessation of communication through the senses. The mind therefore acts vigorously, when the powers of the body are unstrung; and it is only advancing another step to suppose, that it can act altogether independently of its material instrument, and survive it. To prove the extreme agility of the mental powers, and their total diversity from any material substances and actions, his lordship enters into some curious details of the phenomena of dreaming, which incontestably prove that it sometimes requires but an exceedingly short period to suggest and complete a long train of incidents. "A puncture made," says he, in one of his illustrations, "will immediately produce a long dream, which seems to terminate in some such accident, as that the sleeper has been wandering through a wood, and received a severe wound from a spear, or the tooth of a wild animal, which at the same instant awakens him. A gun fired in one instance, during the alarm of invasion, made a military man at once dream the enemy had landed, so that he ran to his post, and repairing to the scene of action, was present when the first discharge took place, which also at the same moment awakened him."

* Edinburgh Encyclopedia,—Article, Blacklock.

† Published in 1835.

From these facts, Lord Brougham infers, "the infinite rapidity of thought." "Mark," he says, "what was done in an instant—in a mere point of time. The sensation of the pain or noise, beginning, is conveyed to the mind, and sets it a thinking of many things connected with such sensations. But that sensation is lost or forgotten, for a portion of the short instant during which the impression lasts; for the conclusion of the same impression gives rise to a new set of ideas. The walk in the wood, and the hurrying to the post, are suggested by the sensation beginning. Then follow many things unconnected with that sensation, except that they grew out of it; and lastly comes the wound, and the broadside, suggested by the continuance of the sensation; while, all the time, this continuance has been producing an effect on the mind wholly different from the train of ideas the dream consists of, nay, destructive of that train; namely, the effect of rousing it from the state of sleep, and restoring its dominion over the body. Nay, there may be said to be a third operation of the mind going on at the same time with these two,—a looking forward to the *denouement* of the plot,—for the fancy is all along so contriving as to fit, by terminating in some event, some result consistent with the impression made on the senses, and which has given rise to the whole train of ideas."*

Whether we entirely agree with this reasoning or not, there can be no doubt that the rapidity of thought, evinced in dreaming, is amazing; nor is it easy to elude the ingenious argument for the immateriality of the soul,

* I cannot, without diffidence, differ from such an authority; but I am by no means sure that the view the noble author has taken of these phenomena is perfectly correct. I should rather be inclined to think that the whole series of incidents in the dreams were suggested after the shock which at last put an end to sleep, had been received; and, during the period, somewhat more than an instant, though exceedingly short, which elapsed before the process of awaking had been accomplished; and that the wound and discharge of musketry, imagined in the dream, were not the same as the puncture and the shot which actually took place, but were afterward conceived, like the other parts of the dream. This view disembarrasses the matter of some of its difficulties; but, on any supposition, the dream must have been nearly instantaneous, and the rapidity of the succession of ideas is wonder-

which the author has founded on it; though, if we were to rely on this argument, it might land us in the belief, that the souls of the lower animals, many of which are known also to dream, must be immaterial too.

ful I am disposed also to doubt the validity of the conclusion to which his Lordship comes, that "we only dream during the instant of transition into and out of sleep" Several facts seem to contradict this view, and, in particular, the phenomena of somnambulism, and of speaking during sleep, seem to be conclusive against it The case of Dr Blacklock, for example, cannot possibly be explained on his Lordship's hypothesis

FOURTH WEEK—SUNDAY.

THIS WORLD A STATE OF DISCIPLINE.

The peculiar condition of sublunary things, as imperfect and transitory, is forced on our notice by the circumstances of the external world during the period of winter. The beauty of the year is gone,—the cheerful notes of the lark, of the blackbird, of the thrush, and of the whole choir which poured the voice of love and enjoyment from earth and sky, have ceased in our land, and a brooding ominous melancholy reigns around. This is but one instance of a character impressed, as we have seen, on every thing under the sun. All are full of change and decay; and the state of the natural world is only an emblem of that which subsists in the moral world, where temptation, and sin, and sorrow, have shed their fatal blight over the once glorious prospects of rational and immortal beings.

This condition would be totally inexplicable, were it not for the light thrown on the subject by Revelation. When we are told that we are at present only in the infancy of our existence, placed here in a state of discipline, to prepare us for a higher and more perfect residence, the mystery is unravelled, and we are made to understand, in some degree at least, why it has pleased the All-wise disposer of events to place us in a world where He only displays the brightness of His perfections as it were by glimpses, and casts clouds and darkness over the rest of the scene.

It is true that evil exists; but the Christian knows that it is over-ruled for good. Our Divine Master does not, indeed, remove calamity, but He changes its nature, and gives us power cheerfully to endure it. As His religion shows us the hand of a God of love in every thing,

it causes us to regard distress, from whatever earthly source it arises, as "the chastisement of a Father, who chastens us for our profit, that we may become partakers of his holiness." Hence the Christian is in a condition to feel a constant and delightful dependance on Providence. Thus instructed, he may grieve, but he cannot repine; he may be humbled and afflicted, but he cannot despair. Shall a child, who knows that a Father corrects him in love, murmur under the rod? Shall he not rather bend with humble resignation, and look up with affectionate joy, to the hand which wounds that it may heal?

This would be the effect of faith in the promises of the Gospel, even although the operations of Providence were surrounded with such mysterious darkness, that our limited faculties could perceive in them no traces of Divine wisdom and goodness. But it is no trifling addition to the satisfaction with which we rest in these promises, that God frequently condescends to make bare His holy arm in our sight, that we may follow His hand, as it over-rules earthly events, and controls human passions and affections, so as to render both moral and physical evil an instrument of good.

In reference to our condition as moral agents, and with a view to the powers and faculties, which, as fallen but rational creatures we possess, it is not difficult to perceive in what manner the afflictive vicissitudes of life operate in elevating and ameliorating our character. If life were free from evil, there would be little to employ the judgment, or call into action the latent faculties,—little to rouse, to affect, and to invigorate the human soul. The heroic virtues of fortitude and courage, for example, would be without an object, were there no perils to encounter, and no enemies to subdue. What self-abasement could there be where there was no infirmity? What meekness, what patience, what forbearance, if there were no injustice to sustain, no calamities to suffer, and no injuries to forgive? Where were the

exercise of resignation in a paradise of bliss? Where the trial of faith in a land of righteousness?

The social virtues, too, as well as the personal, could, under such circumstances, only be called into partial action. How could there be any pity, where there was no distress?—any sympathetic joy, where there was no escape from danger?—any compassionate charity, where there were no sins to cover, and no wants to relieve?

Were there no evils, then, either in the circumstances of the external world, or in the moral and physical condition of the society in which we dwell, we should be placed in a state to which our fallen nature is not suited; and some of our noblest faculties would remain unexercised and unimproved. But it is not so. The Christian is under the discipline of Providence, tutored in the school of adversity; and is rendered prudent by disappointment, humble by error, and magnanimous by endurance. Baffled, afflicted, persecuted, but rising superior to calamity, he unfolds his patience, his meekness, his resignation. Experiencing the hatred and contempt of those whom his heart desires to benefit, he learns the divine duty of forgiveness, and is taught to persevere in offices of kindness to the ungrateful. While engaged in these severe but exalted exercises, he becomes sensible of his own inability, and is forced to exclaim, "Who is sufficient for these things?" Thus, he is led to apply to Him who has said, "My grace is sufficient for thee, my strength is made perfect in weakness." Weeping for his sins at the foot of the cross, he feels the virtue of humility taking deep root and growing in his soul, and the graces of faith, of hope, and of joy in the Saviour of sinners, rising to maturity.

In a word, the disciple of the Man of Sorrows, is exposed to temptation, that he may guard against it;—to difficulties, that he may overcome them;—to dangers, that he may rise above them. He is taught, by experience, the unprofitableness of sin, and he hates it,—the emptiness of human honours, and he despises them,—

the worthlessness of earthly pleasures, and he looks beyond them.

Contemplate the servant of Jesus, as, under the guidance of Heaven, he advances through this vale of tears, gradually throwing off the load of his sins,—mixing with the world, that he may learn to despise its follies,—gaining strength by moral discipline, and improving in virtues and graces at every step. In this character, you witness the highest glory of human nature in its state of sin and suffering on earth,—a being worthy of the approbation of angels. You see a soldier taught to fight the good fight of faith, and trained to victory amidst hardships, dangers, and death,—a pilgrim travelling through the wilderness, with steady eye fixed on the Holy Land,—a pupil of God, instructed in the school of His providence,—an heir of immortality, rendered meet for the inheritance of the saints in light.

In this noble, this admirable being, you no longer recognize the fallen descendant of Adam, but the adopted child of God. Amazing change! How superior is this once degraded and wretched outcast to his former self! Clothed now in the armour of God, he goes forth "conquering and to conquer,"—surrounded with danger, but trusting in an unseen arm,—struggling with sorrow, yet kissing the hand which inflicts the wound,—"troubled on every side but not distressed, perplexed but not in despair, persecuted but not forsaken, cast down but not destroyed,"—eluding the snares of the world, and even successfully contending with "principalities and powers, the rulers of the darkness of this world, and spiritual wickedness in high places."

What striking instances of the efficacy of Christian principles, exercised amidst vicissitudes and suffering, do we discover in the Apostles of our Lord, who rejoiced when they were counted worthy of stripes for the sake of their beloved Master, in whom "tribulation wrought patience, and patience experience, and experience hope;" and whom "hope made not ashamed, because the love

of God was shed abroad in their hearts." And, above all, what a dignified and lovely example of the same principle do we behold in Christ himself, whose whole life was an illustration of the power of Divine grace, in calling the noblest faculties into exercise, and thus rendering the character of man "perfect through suffering;" and who could,—at the close of His earthly career, when He saw the time immediately at hand, so full of unutterable horrors to His human nature, in which the whole world was to be combined against Him, in which His very disciples were basely to forsake their Master, and allow Him to tread the wine-press alone, and in which, during the agony of mysterious sufferings, such as the Son of God alone could endure, the blood-drops of anguish were to burst from every pore of His sacred body, —who could, I say, even in this most appalling hour of the power of darkness, preserve unshaken His confidence in an unseen God, and feeling that he was not alone for the Father was with Him, could in pious resignation exclaim, "Father, not as I will, but as Thou wilt!"

But there is a far higher consideration which gives a peculiar character to the troubles of life, and stamps on them an inestimable value. They prepare mortal man for immortality. Here is the true source of Christian consolation. What are a few fleeting years of imperfect enjoyment, or even of positive calamity, when, through that very condition, we shall be rendered meet to enter the kingdom of God, and dwell with Him for ever? Who would not go on a pilgrimage through this dark and howling wilderness, when he sees rising before him, in all their grandeur and beauty, the everlasting mansions of the promised land? Who would not cheerfully bear the light affliction of a present moment, when he knows that it is "working out for him a far more exceeding, even an eternal weight of glory?"

FOURTH WEEK—MONDAY.

I. THE STARRY HEAVENS.—GENERAL REMARKS.

Nothing is better calculated to raise the contemplative mind to the great Author of all things, than a view of the starry heavens, when night has cast its deep shade over the face of Nature, and the frost of winter has not only converted the earth into stone, and the waters into crystal, but has charmed the exhalations from the air, and endowed it with such a beautiful transparency, that each little star shoots its radiance on the eye, and the whole sublime hemisphere seems like an immense and gorgeous dome, studded with diamonds; a fit temple for the worship of the Creator. The untutored savage, though he regards the stars only as so many lamps suspended from the azure vault, to enlighten and cheer his abode, is struck with admiration at the gift; and, with a heart overflowing with gratitude, falls down to bless the Great Spirit who bestowed it. Ignorance and astonishment have gone still farther; and, in almost all nations, traces are to be found of the worship of the heavenly bodies,—a rude, but not altogether unnatural form of religion to the uninstructed mind. The "Hosts of Heaven," are assuredly the most striking and appropriate visible emblems of the glory of the Almighty Unseen; and, where the mind has been unaccustomed to reflect on any objects but those which strike the senses, the mistake may, without difficulty, be accounted for. Certainly such a belief is neither so strange nor so revolting, as the worship of cows and serpents, or even of men and devils, with examples of which the history of heathen mythology abounds.

Science, however, even in its earliest efforts, easily shook off this superstition; and, as it advanced, opened up new wonders in the sky, which extended the views,

while they intensely excited the curiosity of man, and gave deep exercise to his intellectual faculties. Hence have resulted discoveries which have overwhelmed the mind with astonishment. It does appear little less than miraculous, that a worm of earth, like man, who is bound to a little spot of this remote planet; whose abode upon it is but threescore and ten years; whose bodily strength is inferior to that of many other animals; whose powers of vision are so limited; whose intellect, in ordinary circumstances, rises so little beyond a mere provision for daily subsistence; that this being, with faculties and means apparently so inadequate, should have been enabled, by dint of an insatiable desire of knowledge, and an unwearied perseverance, to overcome so many difficulties, and to forge a key, by which the mysteries of the universe have been unlocked, and a near view has been obtained of the secret springs, which, under the fiat of the Creator, move the amazing machinery of the material world. Little did the early inhabitants of the earth think, when they gazed, in stupid surprise, on the tiny sparks which bespangled the heavens, that each of these was a globe of fire, compared with which the earth they inhabited, was but as a ball, which a child tosses in his hand; or that the distance at which they were situated, was so amazing, that a hundred millions of miles was but as the length of an infant's step. Yet these are truths now familiar to every mind, and established by demonstrations, on which scepticism itself dare not breathe a doubt.

The world of wonders into which astronomy introduces us, is calculated at once to enlarge and to depress the mind; to depress it with a sense of its own insignificance; to enlarge it with views and exercises so immense, that, as it expands, it perceives more and more clearly the immeasurable vastness of the grasp it is required to take; and, though constantly enlarging, in proportion to its efforts, feels itself, at every step, left hopelessly behind, till at last it is lost in infinitude.

When a man confines himself to his own little locality, and looks around him on the subject earth, which his plastic hand converts from a wilderness into a garden; or on the lower animals, whom he subdues to his will, and causes, by the superiority of his mental powers, to supply his wants, and administer to his comforts; or, even on the waters of the far-spread ocean, whose proud waves he conquers, and over whose trackless wastes he makes his way; or on the free and capricious air, whose fury he controls, and whose blandness he renders subservient to his pleasures or his profit,—in such contemplations, he may find much to foster self-complacency, and to persuade him that he is, in reality, that lordly being which pride and vanity delight to portray. But the scenes which astronomy unfolds, are altogether of a different tendency, and ought to repress those swellings of self-love, which a more partial and contracted view of his situation may excite. The voyager who has compassed the earth, when he returns to his native village, is surprised to find that every thing has, to his view, contracted in its dimensions, and become comparatively mean and sordid in its appearance. The houses have shrunk into hovels; the village-green, from a broad-spread lawn, has dwindled into a miserable court-yard; miles have diminished into furlongs; and magnificent estates into sorry farms. This effect has been produced by a contrast with the expansion of his own views, and a similar result arises from the contemplations of the astronomer. Expatiating in the infinity of the universe, the things of earth seem to lessen while he regards them. As he pursues his inquiries, the contrast becomes daily more apparent and more mortifying. He begins to perceive an emptiness in those things which formerly engaged his attention, and interested his affections, which he did not previously suspect. He finds himself placed on a little planet, whose comparative insignificance is such, that, were it struck from the face of creation, its fate would be but like that of a falling star, which loses itself in the heavens, and is

remembered no more. And, as to himself, what an atom is he? How humbling and appalling is the thought!

But the mind cannot rest here. If the creation be so inconceivably extensive, what is the Creator? This is the most interesting and elevating of all inquiries. When the mind has dwelt upon it, till its importance is appreciated, and its various bearings perceived, and then turns back upon itself, the reflection naturally occurs, "Am not I a child of this Almighty Parent?" Is it not in His universe that I exist? Has He not constituted me a part of the system which His Infinite Wisdom has established? And what, then, is that system with reference to me, and the race with which I am connected?

Such views open up, to the inquiring mind, the whole field of Natural and Revealed Religion, and lead irresistibly to the conclusion, that there is no satisfactory account of man's nature and destiny, but in the inspired word, and no resting place for his hopes, but in the life and immortality which have been brought to light in the Gospel of Jesus?

FOURTH WEEK—TUESDAY.

II. THE STARRY HEAVENS.—GRAVITATION AND INERTIA.

If it be true, as there is every reason to believe, that the fixed stars, which sparkle in the heavens, are suns like our own, shining, as they certainly do, by their own light, and shedding their radiance on other worlds, a view of creation is opened up to us, which it is both delightful and overwhelming to contemplate; and to this view we shall afterward turn. At present let us take a rapid survey of the system of which we ourselves form a part.

Our star (for the sun, considered with reference to the universe, deserves no higher name) appears larger than

other stars to us, only on account of its nearness; but when we call it near, we speak relatively; for it is known to be separated from us by the amazing distance of 95,000,000 of miles. It is the centre of our planetary system; that is to say, there are certain bodies similar to our own globe, which bear to the sun the same relation, being, like the earth, attracted to it by the all-pervading law of gravitation, and only kept from falling into it,—as a stone when thrown falls to the ground,—by the velocity with which they move in a different direction. The two well-known laws, so simple in their nature, and yet so vast in their effects, by which the whole creation is moulded and regulated, have, ever since their discovery as universal agents, been most justly regarded with the highest admiration; and it is not easy to conceive any thing capable of impressing on the mind a more exalted view of the power and wisdom of the Creator. It would be inconsistent with our plan to enter deeply into this subject; but some cursory observations on a matter of such intense interest, and so directly illustrative of the perfections of God, cannot be considered out of place. Every one is familiar with the law of gravity or weight,—that mysterious power, which, acting uniformly, draws all things downward, toward the centre of the earth. It is in virtue of this law, that, were I to open my fingers, the pen with which I write would fall flat upon the paper. It is the same law which causes the ink to flow upon the paper from my pen, the paper to lie steadily on my desk, and the desk itself to stand firmly on the floor. Nay, it is this very law which gives solidity to the ground on which I tread, which has formed it into a globe, and which prevents it from dissolving into its original atoms. The properties of this unseen agent are too palpable, in relation to our own sphere, to have escaped the attention of the earliest inquirers into nature. But it was reserved to a far later period to demonstrate, or even to conjecture, that the very same power, which produces such salutary effects

in the earth, is not only an essential property of all matter, but acts at the greatest distances, and preserves the balance of the universe.

The other property, which, combined with gravitation, is employed in regulating the machinery of creation on the great scale, is also familiar to the most ignorant, in regard to some of its qualities. Every child knows, that a stone thrown forcibly from the hand, or an arrow shot from a bow, will continue for some time to move forward in the direction in which it has been projected; but, then, this power of continued motion, as it comes under ordinary observation, is only very limited in its operation, because it is counteracted both by the attraction of the earth and the resistance of the air, and no force which human skill can apply, is sufficiently powerful to give an impetus to any body, capable of overcoming, for a length of time, these opposing forces. In the principle itself, however, there is no limit; and the law is simply this, that while a body at rest will, if not disturbed, remain for ever in that state,—a body once set in motion, will, when not acted on by some modifying or counteracting force, move on continually, without deviation or intermission, in a straight line. This is the law of *inertia*,—a law which is not less universal than that of gravitation.

Now, to understand the operation of these two laws in relation to each other,—first, suppose a small body, placed at rest, in the neighbourhood of a large one, also at rest, both of them in empty space. The mutual attraction would immediately begin to operate, and they would move toward each other till they met, and that with a rapidity proportioned to the quantity of matter contained in each, the larger most powerfully attracting the smaller. Suppose, again, that the smaller body, instead of being placed at rest, was projected with a certain velocity in a direction different from that in which the other was situated. That velocity might be very great; and then, after a mutual disturbance, arising from

the reciprocal attraction, the moving body would disengage itself from the other, and fly off in boundless space; or it might be very small, and then the *vis inertia* would be overcome, and the two bodies would fall toward each other, and unite; but, if the projecting force were, within certain limits, proportioned to the gravitating force, the consequence would be, that there would be a certain point in the progress of the moving body, in which the two powers would balance each other, and then that body would continue to move, indeed, but in a constant circuit round the attracting force, which would thus become its centre of motion, and its course would be in an oval or in a circle, according to the force and direction of the motion originally impressed.

This is, in fact, the principle by which the whole planetary system is governed. The sun, a body of vast dimensions, is the centre of attraction to which all the planets gravitate, and into which they are prevented from falling only by the opposite power of *inertia*. The two forces, with the nicest exactness, balance each other; the former, in reference to this principle, being called the centripetal, and the latter the centrifugal motion; and thus the great machine is kept in action, and the planets wheel steadily in their respective orbits, and perform their various beneficent functions. I may add, that this is the principle, not of the solar system only, but the system of the universe.

" O, unprofuse magnificence divine!
O, wisdom truly perfect! thus to call
From a few causes such a scheme of things,—
Effects so various, beautiful, and great,
An universe complete!"

THOMSON.

FOURTH WEEK—WEDNESDAY.

III. THE STARRY HEAVENS.—THE PLANETARY SYSTEM.

In the account of the creation given by Moses, the heavenly bodies are spoken of merely with reference to the earth, and the living beings which were created to inhabit its surface. Any other view would have been altogether misplaced, and inconsistent with the design of Revelation. The words of the inspired writer, therefore, are, "God said, let there be lights in the firmament of the heaven, to divide the day from the night; and let them be for signs, and for seasons, and for days, and for years; and let them be for lights in the firmament of the heaven, to give light upon the earth; and it was so. And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: He made the stars also."

This account very accurately and distinctly enumerates the uses of the sun, moon, and stars, so far as the inhabitants of our planet are concerned; but there is another, which may be called the philosophical view of the subject, on which man was wisely left to exercise his own powers. This treats of the heavenly bodies, with reference to each other, and to the universe. Here a new and most wonderful scene opens to our view, bright with the glory of the Divine perfections; and this is the scene which now presents itself for our consideration.

Keeping in mind that our object is not to write a treatise on astronomy, but merely to point out some remarkable facts in the construction of nature, which can only be referred to an intelligent and benevolent First Cause, let us look more minutely at the appearances of the starry heavens. Besides the moon, which shall be afterward considered, one of the first things which strike an observer, is, that the great mass of the stars, though ap-

parently in constant motion round a point from east to west, occasioned by the diurnal movement of the earth, are yet stationary—or, in other words, preserve the same relative position—with reference to each other; but that there are a very few of those lamps of night which follow a different law, continually changing their place, and making progress among the rest, from west to east, with different degrees of velocity. It was discovered too, as soon as the telescope was applied to the heavens, that, while no known magnifying power could increase the apparent dimensions of the fixed stars, these moving bodies were readily affected by that instrument. Such circumstances indicated an essential difference in the nature of the two classes of stars; and, in the progress of science, it was found that the latter were no other than bodies partaking of the conditions of our own globe, and moving, like the earth, in a constant orbit round the sun. These are called planets.

To the ancients, only five planets were known,—Mercury, Venus, Mars, Jupiter, and Saturn. To this list, modern science has added the Earth,—which takes its place, with relation to its distance from the sun, between Venus and Mars,—and Uranus, or Georgium Sidus, which is the most distant of them all. Besides these, a still later discovery has been made, of four other planetary bodies, which move in orbits considerably more eccentric than the rest, and are of much smaller dimensions, whose situation has been found to be between Mars and Jupiter. All these planets are nearly globular, and move round their own axis, as well as round the sun. Some of them have attendant bodies, called satellites, of which our moon is an example, moving round their primary planets, nearly in the same plane in which the latter revolve round the sun, and nearly also in a similar orbit. Now, of the orbit of these bodies, the sun, as has been observed, is the centre; and the first observation which may be made in reference to this arrangement, as indicating wise design, is, that this central body is the source

of light and heat. Had the world been, as the atheist contends, a mere fortuitous concourse of atoms, granting, for the present, that other arrangements might be accounted for, on causes entirely mechanical inherent in the constitution of matter, there seems to be no reason deducible from such causes, why the great body, whose enormously superior size constituted it the centre of motion to the smaller globes, should, at the same time, be endowed with those peculiar properties so essential to the very existence of vegetable and animal life. How comes it that any of the bodies belonging to our system should shed light and warmth over the rest, and that of these, only one should be endowed with such properties? If this can be accounted for, then why does that body occupy the position at the centre,—the only position, be it observed, which could render these life-sustaining properties available for the purpose? There seems to be no possible reason, except that of Creative Intelligence, why the illuminating body should not be one of the planets; and, if that had been the case, how irregular, and how totally inefficient would have been the operation.

This proof of contrivance, which is strikingly and convincingly illustrated by Whewell, attracted the attention of Sir Isaac Newton himself. In his correspondence with Bentley, he concedes that the sun and fixed stars might be formed by the mere force of attraction, and might exhibit their present appearances, provided the matter were of a lucid nature; "But," adds he, "how the matter should divide itself into two sorts, and that part of it which is fit to compose a shining body, should fall down into one mass, and make a sun; and the rest, which is fit to compose an opake body, should coalesce, not into one great body, like the shining matter, but into many little ones; or, if the sun were at first an opake body, like the planets, or the planets lucid bodies, like the sun, how he alone should be changed into a shining body, whilst all they continue opake; or all

they be changed into opake ones, whilst he continued unchanged, I do not think explicable by mere natural causes, but am forced to ascribe it to the counsel and contrivance of a Voluntary Agent."

It seems impossible that any unbiassed mind should hesitate to acquiesce in the conclusion of this great man; and thus, from the very existence of a sun in the centre of our system, a satisfactory proof is drawn of the being of a God.

FOURTH WEEK—THURSDAY.

IV. THE STARRY HEAVENS.—THE SUN AS THE SOURCE OF LIGHT AND HEAT.

In considering the advantages derived from that obviously intentional and most wise arrangement, by which the sun has been made the centre of our system, reference was necessarily made to that body, as the source of light and heat. A cursory view of some circumstances connected with these properties, seems, therefore, to suggest itself as an appropriate subject for this day's consideration.

The sun is a body of such immense magnitude, that it fills a space nearly twice as large as is comprehended within the orbit of the moon in its motion round the earth,—being in diameter no less than 882,000 miles, and in bulk considerably more than a million of times larger than the earth. From this amazing orb, light and heat are in some manner communicated to our planet, and to all the other planetary bodies, with a velocity which surpasses conception, the influence, whatever it is, travelling at the rate of 12,000,000 of miles in a minute, and reaching our globe in something less than eight minutes.* It was supposed by Sir Isaac Newton, and has, till lately, been assumed as a fact, that the properties in

question were transmitted from the sun by *emanation;* that is, that he was continually throwing off from his surface, a material substance, of extreme tenuity, possessing these properties. Late discoveries, however, of certain peculiarities in the nature of light, have given currency and probability to another opinion, namely, that the sun is no more than the spring which communicates activity to qualities or substances residing in our own atmosphere, from which the phenomena of light and heat are derived. This is called the theory of vibrations; and it has been aptly illustrated by the manner in which sound is caused and propagated. It supposes an ethereal fluid diffused through the universe, of inconceivable rarity and elasticity, to which the luminiferous vibrations are communicated, and through which they are transmitted.

It is not the province of this work to enter into any discussion on this curious subject; and it is enough for our present purpose to know, that the Creator has caused the most salutary effects to depend on the presence and influence of this central body. Whether by vibration or by emanation, the properties of heat and light, indispensable to the existence of organized beings, in all their different grades, are, by means of the sun, adequately conveyed to the earth, otherwise dark and dead. We shall by-and-by have occasion to notice some of the qualities of heat, the partial absence of which, in our climate, at this season of the year, indicates how necessary this subtle agent is to life and enjoyment. Let us, at present, look at the kindred element of light, and we shall see that its operation is scarcely less indispensable in a world constituted as ours.

It is necessary to vegetable life. Without light, indeed, vegetables might grow. Some of the most important powers of vegetation are carried on under ground, and in darkness, and the energies residing in the roots are sufficient to cause the plant to shoot forth its stem, and even to expand its leaves; but then, light is essen-

tial to the health, and, as it should seem, to the productive powers of plants, so that, without this genial influence, they could not survive beyond one generation. Colour, and to a considerable extent, strength of fibre also, are bestowed on vegetables by the influence of light, a circumstance which is familiar to gardeners, who *blanche* their celery, and other productions, by causing them to grow in the dark; and which is known to every one who has observed the colourless and feeble shoots of potatoes, for example, which happen to grow in a cellar or a pit, and the wonderful instinct which leads these shoots eagerly to extend in the direction of the slightest chink through which light is introduced. The manner in which light operates in bestowing a wholesome state on plants, appears to be by a chemical action, by which they are enabled to imbibe carbon, and disengage oxygen. In the absence of light, this action is reversed; and it is worthy of remark, that the operation of this agent, in the process of vegetation, is not only healthful to the plant, but also useful to animal life, in freeing the atmosphere from some noxious qualities, and restoring it to a salubrious condition. It seems unnecessary to remark, that there is here the unequivocal impress of designing Intelligence.

It is further obvious, that the influence of light on vegetables, is extended likewise to animal life, which derives its support from these productions. But this is not all: for, on living creatures, its more direct effects are not less necessary. This agent is essential to sight, a faculty of such paramount importance; and the eye, an organ of most curious and peculiar construction, is, beyond all doubt, framed for the express purpose of receiving its impressions. Nothing can be more worthy of observation, than the manner in which the instrument of vision is adapted to the properties of the agent. Light is reflected, in all directions, from every object on which it falls; and, by the construction of a *camera obscura*, most skillfully contrived, these reflected rays convey

form, colour, light, and shade,—a perfect representation, in short, of external objects,—into the interior of the head; thus, by a mysterious connexion between mind and matter, giving rise, in living beings, to the faculty of sight, with all its well known properties and advantages. Who can doubt that there is here a proof of skill and adaptation,—that light was made for the eye, and the eye for light?

FOURTH WEEK—FRIDAY.

V. THE STARRY HEAVENS.—MOTIONS OF THE PLANETS.

As the fountain of light and heat is placed, by the great Creator, for obviously wise reasons, in the centre of our planetary system, it is natural to expect, that all the arrangements connected with this appointment, should be found so contrived, as to correspond with the beneficent intention; and the more deeply we inquire into the subject, the more distinctly do we observe such an expectation realized. The object of the present paper, will be to illustrate this position, with reference to the motions of the planetary bodies.

And first, with regard to their orbits. We have already stated, that a planet, in its path round the sun, may, according to the laws of motion, describe either an oval or a perfect circle. I have now to observe, that the oval might either be very long or very short, there being, so far as appears, nothing in the mechanical law tending to restrict the elliptical form. But it is obvious, that, if the circuit should prove very eccentric, the greatest inconveniences would take place, in a world constituted like ours; and, indeed, a total destruction of animal life would be the necessary consequence; because, at the point of the orbit nearest the sun, the fervour of his rays would be destructive; and, at its greatest dis-

tance, his apparent size, and his illuminating and warming power, would diminish together, till the land and the sea would yield equally to the ungenial influence, and be converted into one frozen and lifeless mass. Among the almost numberless forms, therefore, which the orbits of the planets might assume, the production and maintenance of organized existences, such, at least, as those with which we are familiar, required that a selection should be made within narrow limits; and that selection has been made. Every one of the planets, with the exception only of three of the smallest of these bodies, viz. Mercury, Juno, and Pallas, which their peculiar circumstances may account for, move in an orbit nearly approaching to a circle. The earth's orbit, for example, only deviates from an exact circle, by the thirteenth part of its distance from the centre; and, though the deviation of all the other planets, except Venus, is somewhat more than this, that deviation is so small, unless in the instances already alluded to, that it need scarcely be mentioned as a source of inconvenience. "Taking the solar system altogether," says Whewell, "the regularity of its structure is very remarkable. The diagram, which represents the orbits of the planets, might have consisted of a number of ovals, narrow and wide in all degrees, intersecting and interfering with each other, in all directions. The diagram does consist, as all who have opened a book of astronomy know, of a set of figures, which appear, at first sight, concentric circles, and which are very nearly so; no where approaching to any crossing or interfering, except in the case of the small planets, already noticed as irregular. No one, looking at this common diagram, can believe that the orbits were made to be so nearly circles, by chance, any more than he can believe that a target, such as archers are accustomed to shoot at, was painted in concentric circles by the accidental dashes of a brush in the hands of a blind man." *

* Whewell's Bridgewater Treatise, p. 156.

Another peculiarity in the motions of the planets, is, that they are all in the same direction, and nearly in the same plane. It is quite evident, that, had chance originated these motions, they might, and probably would, have moved round the sun, both as to direction, and as to the plane of their orbit, in very different ways. Now, to those who are acquainted with the properties of the law of attraction, it will appear evident, that a most important object is served by the arrangement which actually subsists. Let it be observed, that such is the extraordinary nature of this law, that every particle of matter attracts, and is attracted by every other particle, the power, of course, being greater, in proportion to the quantity of each mass, and its nearness. The consequence of this is, that not only does the great central mass attract the smaller bodies, so as to cause them to revolve round it, but each of these smaller bodies also attracts the others; and this mutual attraction, which, it is easy to perceive, must be of a very complicated nature, and may produce the most extensive effects, requires to be nicely adjusted, in order to preserve the stability of the system. If the numerous globes, of which our system is composed, were to move in their respective orbits, without any such adjustment, our system would be far indeed from being stable. The disturbing forces, which might only be trifling, when a year, or even an age, was considered, might, in a long series of ages, accumulate to such an amount, as totally to disorganize and subvert the whole frame.

Nor is this a mere gratuitous hypothesis. Astronomers have actually discovered, in our solar system, an apparent tendency to derangement. Changes have been taking place, owing to the cause just mentioned, which, at first sight, appear to be of an alarming nature. The eccentricity of the earth's orbit has been gradually diminishing; the moon has been approaching nearer the earth, and accelerating her motion; and the obliquity of the ecliptic has been diminishing. These changes

have been going on, from the period of the first scientific observations, to the present day, and are still in progress. Are they to continue without end? If so, the present system of things is tending to destruction.

This question has, by an amazing effort of calculation, been satisfactorily answered. Aided by the mathematical investigations of ages, two celebrated French philosophers, Lagrange and Laplace, have solved the problem, and have demonstrated, that "the planetary system will only oscillate about a mean state, and will never deviate from it, except by a very small quantity."* This remarkable result depends on these three conditions,—that the orbits of the planets are nearly circular; that these orbits are nearly in the same plane; and that they all move in the same direction.

Had any one of these conditions been different, the equilibrium of the system would not have been maintained; the tendencies to derangement would not have been counteracted, but, on the contrary, year after year, would have been accelerated by accumulation; and, sooner or later, the whole fabric would have broken up, and been dissolved by its own inherent defect.

It is unnecessary to enter into any argument, to show that the combination of the various arrangements alluded to, could not have occurred without design;—that the adjustment is that of an Intelligent Cause; and that it affords an unequivocal proof of consummate and adorable wisdom.

FOURTH WEEK—SATURDAY.

VI. THE STARRY HEAVENS.—RESISTING MEDIUM.

We have seen, in the case of the planets, including also their satellites, that Supreme Wisdom has so ba-

* Laplace, Expos. du Syst. du Monde, p. 441.

lanced our system, that the disturbing forces, to which it is subjected by the mutual attraction of the heavenly bodies, will, in consequence of simple but selected arrangements, in the course of ages, correct themselves, so as never to endanger any violent change from such mechanical causes, so far, at least, as the power of attraction is concerned. This is highly satisfactory, as a demonstration against the atheistical doctrine, which would exclude from the universe the operation of a Designing Cause. It does not, however, prove the absolute permanency of the system, and we know, from the "more sure word of prophecy," that it is not destined to last for ever.

There is, indeed, another element to be taken into consideration, which the French philosophers, already alluded to, have overlooked or rejected, but which bears directly upon the question of inherent stability,—I mean the question regarding a resisting medium. All their calculations have been founded on the two simple powers of attraction and inertia, under the supposition that these powers acted in empty space, without the existence of any impeding force. If it be found, therefore, that a resisting medium actually exists in the system; that is, that there is some fluid matter, however rare, in which the celestial bodies move, then this one fact will overturn the conclusion as to the absolute and inherent permanency of the present system of things, so far as mechanical powers are concerned. Nor will this discovery invalidate the reasoning in the preceding paper; for it will still remain a truth, worthy of the deepest admiration, that the plan was adopted, which, of all others, is best calculated to balance and counteract disturbing forces, even although other considerations should prove that the system was not intended to be eternal. It is this principle which secures the equal and salutary working of the system, while it lasts, and which bestows upon it properties suited for the habitation of organized existences, during that period; and this is the whole

extent of the view for which we have been contending.

Is there, then, a resisting medium,—a fluid in which our system floats? or are our planetary spheres wheeled in empty space? The diffusion of light throughout the universe, might, of itself, form a powerful argument for the existence of such a medium, on whatever theory its properties are accounted for. Light is either an emanation from the great central body, and then that emanation must be something material; or it is an exciting cause of vibratory motion; and, in that case, the vibrations must apparently be conveyed through some material substance. In either case, the theory of an absolute vacuum seems to be untenable. But, independent of this view, some facts have been very recently discovered, which cannot well be accounted for, but on the supposition of a resisting medium. I allude to certain circumstances occurring in the motion of one of the comets belonging to our solar system, to which the importance of *Encke's* observations have justly caused that astronomer's name to be attached. The revolution of this body round the sun, is found to be completed in a period of about three years and four months, while its orbit is so eccentric and elongated, that it is more than ten times nearer the sun in one part of its course, than in another. The materials of which it is composed, seem to be exceedingly thin and transparent, so much so, indeed, that the stars may be seen through the most condensed part of its nucleus, without any apparent diminution of their brilliancy. In 1786, this comet was first observed; but it was not till 1822, that its periods were accurately determined; and then Encke, on comparing the calculated with the observed places, perceived a difference, which he attributed to the effect of a resisting medium. It was again the subject of observation in 1825, in 1828, and still more recently; and the conclusion has become general, that the obvious and constant disturbance of its course, arises from no other cause than that of its being affected by its motion in an ethereal fluid.

This fluid, however, must be of inconceivable rarity, and would probably not produce any apparent effect in its velocity, were it not from the small quantity of matter contained in the vapoury sphere, which, as will easily be perceived, must increase the power of resistance of the medium through which it moves. Light and loose, however, as the body is, it has been found to be acted on by the solar and planetary attraction, in the same manner with the other heavenly bodies; and the result having been accurately calculated, what Sir J. Herschell calls a *residual phenomenon*, has been discovered, which has given rise to the inference of a resisting medium.

The effect, however, though something very discernable, is yet but trifling; and, what may appear strange, this retardation of the motion, causes the body to perform its revolutions round the sun more quickly. The reason is, that the increasing slowness of the motion, has the effect of augmenting the relative power of the sun's attraction, thus drawing the comet nearer to himself, and shortening its orbit. Within the last fifty years, in which its course has been observed, it has been found, that, while it has advanced about ten days farther in its path, than would otherwise have been the case, the time of its revolution has been diminished by about two days.

Now, the very same power of resistance, which acts so perceptibly on this unsubstantial body, must act also on every other body which passes through the same medium; and, however small the effect produced may be, it must be something, which, though not, perhaps, sufficient to produce any sensible effect on those more solid bodies, for many centuries, must yet, in reference to a period of eternal duration, be sufficient to derange, and finally to destroy, the whole system. As yet, no retardation of the planetary bodies has been observed, which could be referred to the existence of a resisting medium, because our observations extend to a period too limited; but this may only prove the extreme remoteness of the final catastrophe. "It may be millions of millions of

years," says the interesting author, whom we chiefly follow in this part of our work, "before the earth's retardation may perceptibly affect the apparent motion of the sun; but still the day will come (if the same Providence which formed the system, should permit it to continue so long), when this cause will entirely change the length of the year, and the course of our seasons, and finally stop the earth's motion round the sun altogether. The smallness of the resistance, however small we choose to suppose it, does not allow us to escape this certainty. There is a resisting medium; and therefore the movements of the solar system cannot go on for ever. The moment such a fluid is known to exist, the eternity of the movements of the planets becomes as impossible as a perpetual motion on the earth."*

The obvious use to be made of the fact now stated, is, that our present system of things, which must have an end, must also have had a beginning. We have not yet arrived at that end; and therefore an eternal revolution of ages has not passed. A period of commencement implies a Cause; the order and regularity of the system implies an *Intelligent* Cause; and thus the idea of a Creator is forced upon us; and, instead of an eternal operation of mechanical powers, and an eternal succession of organized existences, which is the dream of the atheist, we see a system, glorious with the impress of a Divine hand, and rejoicing in the smile of a present Deity.

* Whewell's Bridgewater Treatise, p. 200.

FIFTH WEEK—SUNDAY.

DIVINE AND HUMAN KNOWLEDGE COMPARED.

When the philosopher compares his knowledge of external nature with that of his fellow-men not conversant with such high studies, there is danger of his becoming vain of his attainments. He has unbarred the gate of science, and penetrated the mysteries of creation. He follows the course of the sun, and measures the stars, and unravels the mystic changes of the planets, and discovers new worlds in distant space, and puts his finger on the law which sustains, impels, and guides the immense machine of the universe. This sounds proudly; and if we only consider the limited faculties of man, his attainments are undoubtedly worthy of admiration; but when viewed in the light of the Divine perfections, they dwindle and disappear. With reference to these, the capacity of man to acquire knowledge is extremely limited. As he advances but a few steps beyond the ordinary train of his ideas, he is lost in the immensity of his own conceptions. He has not faculties to grasp the wonders even with which he is more immediately surrounded, and how much less to form any adequate idea of the nature and character of the *Self-existent*. Let any man reflect, for an instant, on the divine attributes of Eternity, Infinity, Unchangeableness; and he will at once perceive how imperfectly he comprehends them. Who can do this without being awed, confounded, and bewildered? "Such knowledge is too wonderful for me; it is high, I cannot attain unto it!"

But even supposing we were capable of comprehending all mysteries, and all knowledge, how extremely limited is our sphere of observation. We are placed in a remote corner of creation. What a mere atom is the world which we inhabit, compared with the universe!

Even if we knew every thing under the sun,—nay, if all the powers of nature within our planetary system, with all the transactions of the whole animated creation which it contains, lay naked and open before us, how ignorant, even then, would we be! Worlds on worlds, and systems on systems, would still be entirely unknown to us.

But how little do we know even of the earth which we inhabit! We are confined to a little spot of this little world. How small are the British islands compared to the broad expanse of sea and land! And yet, of this diminutive region, how insignificant is the space with which we are acquainted! And even of the objects within our view, how ignorant are we! Nay, of the things with which we are most familiar, what do we know! We observe their outward appearance,—we can tell what they are to the eye, to the ear, and to the touch; but what they are in their own nature, the greatest philosopher cannot so much as conjecture. Indeed, the very production of organized existences, is an impenetrable mystery. Who can define the secret power by which a single blossom of the spring germinates and grows, opening its beauties to the sun, and embalming the air with its perfumes?

Compared with this stinted portion of knowledge, how amazing is the knowledge of God! As He made all things, He must be intimately acquainted, not only with their properties, but with their very essence. His eye, at the same instant, surveys all the works of His immeasurable creation;—He observes, not only the complicated system of the universe, but the slightest motion of the most minute microscopic insect;—not only the sublimest conceptions of angels, but the meanest propensity of the most worthless of His creatures. At this moment, He is listening to the praises breathed by grateful hearts in distant worlds, and reading every grovelling thought which passes through the polluted minds of the fallen race of Adam.

Another difference between Divine and human know-

ledge, arises from the limited term of man's existence, and the limited extent of his memory. Threescore and ten years sum up the days of his earthly career. In that short period, how little can he learn! How much of that little does he lose by inattention, or by defect of memory and judgment! From books, indeed, he may acquire some knowledge of the past; and from Revelation, still more, not only of the past, but of the present and future. But of what we learn from the works of fallible men, if we were to deduct all that is false or doubtful, how little would remain! And even of the unerring oracles of God, how much is there that we cannot fully comprehend!

To this, also, what a contrast do we find in the knowledge of God! At one view, He surveys the past, the present, and the future. No inattention prevents Him from observing; no defect of memory or of judgment obscures His comprehension. In His remembrance, are stored not only the transactions of this world, but of all the worlds in the universe;—not only the events of the six thousand years which have past since the earth was created, but of a duration without beginning. Nay, things to come, extending to a duration without end, are also before Him. An eternity past, and an eternity to come, are, at the same moment, in His eye; and with that eternal eye He surveys infinity. How amazing! How inconceivable!

But while we thus do homage to the perfections of the Eternal, let us not undervalue the studies by which these perfections are elucidated. Though, when compared with the Divine mind, the mind even of a Newton must sink into utter insignificance; yet, to feeble man, it is great,—it is admirable,—to have removed the veil which lay on the face of nature,—to have pierced, with keen glance, to the suns of other systems, and to have known the law, so simple and so sublime, by which the beauty, order, and harmony of the universe, are sustained. By enlarging our views of nature, the philosopher enlarges

our conceptions of Nature's God. He throws new light on the power, the wisdom, and the infinity of the Creator;—and this is well, but it is not enough. Without a higher principle, his knowledge is ignorance; his wisdom is folly; his light is darkness. Every discovery which extends our conceptions of the Divine power, while it hides from our view the beauty and grace of his paternal character, only places man at a more awful distance from his Maker, and surrounds the throne of the Eternal with new terrors, till, in the full blaze of the Godhead, the corrupted child of earth shrinks,—is consumed,—is annihilated!

O! how unspeakably more cheering and glorious,—how infinitely better adapted to our condition and our wants, would be a simple message from the unseen world, intimating favour to the sinful and perishing race of Adam. And that message has been sent. The Almighty has broken the silence of nature, and sent that message by his own Son.

FIFTH WEEK—MONDAY.

VII. THE STARRY HEAVENS.—THE SATELLITES.

We have considered the arrangements of the planetary system, in reference to its stability, and to the diffusion of light and heat; but there is a contrivance of a different kind, which seems to require a slight notice. The existence of satellites, or secondary planets, as they are called, is a striking concomitant of the system. These smaller bodies attend the primary planets in their course round the sun, partaking of their motion, and at the same time wheeling round them, in an orbit of their own, at greater or less distances. Now, it has been remarked, that, speaking generally, these moons are bestowed as attendants on the planets, in some relation to

their distance from the sun, increasing in number in proportion as we recede from that luminary. The inferior planets, that is, those that are nearer the sun than our earth, have none. The Earth has one; Jupiter, which is five times more distant from the sun than our planet, has four; Saturn, which nearly doubles the distance of Jupiter, has seven, besides the curious anomaly of a ring; Uranus is known to have five, and may, in all probability, have many more, which the extreme remoteness of his situation, at the distance of 900,000,000 of miles, may well render invisible, even with the use of our best instruments. Supposing, however, that this is the case, there are still exceptions to the rule of increase. Mars, and the four other planetary bodies which are stationed between the Earth and Jupiter, have no attendants. As to the ultra-zodiacal planets, the peculiarity of their condition might lead us to expect this deviation; and though it may be more difficult to account for the want of an attendant in the case of Mars, there are few who, on this account, will withhold their assent to the truth of the general observation.

What purpose, then, do these secondary planets serve? This is a question which has been so well answered by Mr Whewell, in reference to our own moon, and in refutation of the sceptical doubts of Laplace, that I cannot suppose any apology is required for the quotation which follows:—

"A person of ordinary feelings," observes this sound philosopher, "who, on a fine moonlight night, sees our satellite pouring her mild radiance on field and town, path and moor, will, probably, not only be disposed to 'bless the useful light,' but also to believe that it was ordained for that purpose; that the lesser light was made to rule the night, as certainly as the greater light was made to rule the day.

"Laplace, however, does not assent to this belief. He observes, that 'some partizans of final causes have imagined, that the moon was given to the earth to afford

light during the night;' but he remarks, that this cannot be so, for that we are often deprived at the same time of the light of the sun and of the moon, and he points out how the moon might have been placed so as to be always 'full.'

"That the light of the moon affords, *to a certain extent*, a supplement to the light of the sun, will hardly be denied. If we take man in a condition in which he uses artificial light scantily only, or not at all, there can be no doubt that the moonlight nights are for him a very important addition to the time of daylight. And, as a small proportion, only, of the whole number of nights are without some portion of moonlight, the fact, that sometimes both luminaries are invisible, very little diminishes the value of this advantage. Why we have not more moonlight, either in duration or in quantity, is an inquiry, which a philosopher could hardly be tempted to enter upon, by any success which has attended previous speculations of a similar nature. Why should not the moon be ten times as large as she is? Why should not the pupil of a man's eye be ten times as large as it is, so as to receive more of the light which does arrive? We do not conceive, that our inability to answer the latter question, prevents our knowing that the eye was made for seeing; nor does our inability to answer the former, disturb our persuasion, that the moon was made to give light upon the earth."*

To show that the light derived from the moon exhibits no proof of an Intelligent Cause, Laplace undertakes to suggest a better arrangement himself, and points out a position of that luminary, which would always cause her to appear full to the inhabitants of the earth. Mr Whewell answers this suggestion by proving, that such a position could only be found by placing the moon four times farther from us than she is at present, which would diminish her apparent size no less than *sixteen* times, and, of course, proportionally diminish her light.

* Whewell's Bridgewater Treatise, p. 174.

Whether or not this arrangement would be preferable to the present, may well be doubted; but even if its superiority could be demonstrated, it seems doubtful if the influence of the disturbing forces, which, on such a supposition, would certainly act more powerfully, would suffer the arrangement to be stable.

But, even allowing the full force to Laplace's objection, which the validity of his suggestion could with any show of reason afford, it amounts, after all, just to this, that the provision thus made for the comfort and happiness of living creatures, and especially of man, is mingled with imperfection and privation. Is not this, however, the precise character which is inscribed on all sublunary things? and does not the analogy which we here discover, serve to confirm the very view of the Divine perfections, as exhibited in his works, with reference to the moral government of the human race, which I have been endeavouring all along to establish? This is a chequered scene of brightness and gloom, of sunshine and shade, of enjoyment and depression; and such is the discipline best suited to our fallen condition.

In turning from our own satellite to those of the other planets, a similar train of reasoning may be applied. These nightly luminaries, attached to Jupiter, Saturn, and Uranus, certainly compensate, in some degree, by their numbers, for the increased deficiency of light, arising from the remoteness of their primaries from the sun. This view will not be successfully redargued by the fact already stated, that Mars, and the four small planets, still more distant than he from the source of light, are destitute of these useful appendages. The answer to such an objection just is, that, according to the analogy of creation, we may expect exceptions for which we may be altogether incapable of assigning an adequate cause; but the ignorance inherent in our limited views, can never invalidate the evidence of facts and principles clearly established.

FIFFH WEEK—TUESDAY.

VIII. THE STARRY HEAVENS.—RELATIVE PROPORTIONS OF THE PLANETARY SYSTEM.

BEFORE concluding our remarks on the system with which we are more immediately connected, it may be useful to take a general survey of the whole, in its relative proportions, that we may be enabled to form to ourselves some idea of the enormous scale on which even our comparatively diminutive department of the universe is constructed. It is exceedingly difficult for the mind to compare very great things with each other; because, beyond a certain point, all proportions seem to be lost in a kind of undefined immensity. We are commonly conversant with things on so minute a scale, being ourselves mere atoms, as it were, of a little planet, that it requires an effort to raise our thoughts to so vast a subject; and, in contemplating it, we are, at every step, forced to feel the inadequacy of our own powers of comprehension. It is reported of some savages, that the scantiness and trifling nature of the objects which occupy their attention, have so contracted their faculty of estimating quantities, that they have no means of enumeration beyond the number of their fingers; and all groups of objects above ten are expressed, in their language, by a word which implies what is innumerable, on account of its immensity. We are surprised at the want of comprehension which this indicates; but it is, in reality, only a greater degree of a defect which belongs to the condition of our nature and circumstances as human beings; and the astronomer himself, familiar as he is with numbers and quantities, the very statement of which startles a less practised mind, comes quickly to a point, at which, though his mechanical power of calculation may continue, his imagination flags, his judgment is con-

founded, and he finds himself much in the state of the untutored savage.

The author from whom we yesterday made an interesting quotation, adverting to this difficulty, has taken an ingenious method of bringing the relative proportions and distances of the bodies connected with our system, nearer to a level with a common apprehension, by reducing their dimensions. " If we suppose the earth," says he, " to be represented by a globe, a foot in diameter, the distance of the sun from the earth will be about two miles; the diameter of the sun, on the same supposition, will be something above a hundred feet; and, consequently, his bulk such as might be made up of two hemispheres, each about the size of the dome of St Paul's. The moon will be thirty feet from us, and her diameter three inches,—about that of a cricket ball. Thus, the sun would much more than occupy all the space within the moon's orbit. On the same scale, Jupiter would be above ten miles from the sun, and Uranus forty. We see, then, how thinly scattered through space are the heavenly bodies. The fixed stars would be at an unknown distance; but, probably, if all distances were thus diminished, no star would be nearer to such a one-foot earth, than the moon now is to us. On such a terrestrial globe, the highest mountains would be about one-eightieth of an inch high, and, consequently, only just distinguishable. We may imagine, therefore, how imperceptible would be the largest animals. The whole organized covering of such an earth would be quite undiscoverable by the eye, except perhaps by colour, like the bloom on a plum.

" In order to restore the earth and its inhabitants to their true dimensions, we must magnify the length, breadth, and thickness of every part of our supposed models, forty millions of times; and, to preserve the proportions, we must increase equally the distances of the sun and of the stars from us. They seem thus to pass off into infinity; yet each of them, thus removed, has its

system of mechanical, and perhaps of organic processes, going on upon its surface."*

While, by the process of diminution, we are enabled to form a clearer estimate of the relations of those vast bodies which exist in our system, we may accomplish a similar object by magnifying those which, from their minuteness, strain our imagination on the other side. By far the greater part of organized beings are so small, that the human eye, in its naked state, formed only for the discernment of objects of practical utility, cannot detect them. These the microscope discloses; and, while they thus become apparent to the sight, it requires a similar process of the mind to bring their amazing minuteness within the scope of the understanding. "We know," says our author, "that we may magnify objects thousands of times, and still discover fresh complexities of structure. If we suppose, therefore, that we thus magnify every member of the universe, and every particle of matter of which it consists, we may imagine that we make perceptible to our senses the vast multitude of organized adaptations which lie hid on every side of us; and, in this manner, we approach toward an estimate of the extent through which we may trace the power and skill of the Creator, by scrutinizing his work with the utmost subtlety of our faculties."

These views are calculated to impress the mind with very elevated and interesting conceptions of the stupendous nature of those Divine perfections, by which our system was originally called into existence, and is still upheld and governed; but it is, after all, but the entrance to a survey of the universe. The planetary system to which we belong, is but that of a single star; and, when we cast our eye over the heavens, and endeavour to rouse our faculties to the comprehension of the fact, that every one of those little twinkling lights with which the blue vault is bespangled, with the exception only of those few which are known to change their relative positions, is a

* Whewell's Bridgewater Treatise, pp. 273, 274.

sun like our own, and that each of them has, in all probability, a planetary system analogous to ours, we want words to express the sublimity of the conception, and receive a more vivid impression of the feelings of the poet of the Seasons, when, overpowered by the vastness of his subject, he exclaims,

——————— "I lose
Myself in HIM—in light ineffable!
Come, then, expressive silence—muse HIS praise."

FIFTH WEEK—WEDNESDAY.

IX. THE STARRY HEAVENS.—DISTANCE OF THE FIXED STARS.

THE precise distance of any of the fixed stars cannot be ascertained by such means as have hitherto been employed by astronomers, although it may be considered as certain, that the nearest of them does not approach our sun so near as *nineteen billions* of miles! The calculation by which this inconceivable distance is established, is entirely satisfactory, and may readily be understood. I shall state it in as popular a manner as I can. As the earth moves round the sun at the average distance of about 95,000,000 of miles, it follows that she must be nearer those fixed stars that lie in the plane of her orbit, at one period of the year than at another, by double that distance, or 190,000,000 of miles; but it has been found that an approach of this immense amount makes not the very slightest perceptible alteration in the apparent size of these bodies; and hence we justly conclude, that 190,000,000 of miles is but as a point in comparison of the space which still intervenes between us and them. On this fact, we may form a loose estimate of a distance within which the stars, situated as I have mentioned, cannot be stationed. But we must take another and somewhat more scientific method of judging with regard

to the distance of those stars which are otherwise situated. It might be expected, that the vast diameter of the earth's orbit would produce some perceptible amount of annual parallax in the stars; that is to say, that, in moving over this immense space, some change would be effected in their relative position, just as a lateral movement of a few miles along a road produces a change in the outline even of the most distant hills. Were this the case, the distance of the stars might be ascertained with some degree of accuracy. But it is not so: "After exhausting every refinement," says Sir John Herschel, "astronomers have been unable to come to any positive or coincident conclusion upon this head; and it seems, therefore, demonstrated, that the amount of such parallax, even for the nearest fixed star which has hitherto been examined with the requisite attention, remains still mixed up with, and concealed among, the errors incidental to all astronomical demonstrations. Now, such is the nicety to which these have been carried, that, did the quantity in question amount to a single second (that is, did the radius of the earth's orbit subtend, at the nearest fixed star, that minute angle), it could not possibly have escaped detection and universal recognition." Hence, by a simple mathematical process, he is led to the conclusion, that the distance of the stars cannot be so small as 4,800,000,000 radii of the earth, or 19,200,000,000,000 miles! But, for any thing we can tell, the very nearest of them may be much farther removed from us than even this inconceivable distance.

Now, with regard to the size of these bodies, remote as they are, science has invented a way of forming some comparative estimate. Dr Wollaston, by experiments on the light of Sirius, the brightest of the fixed stars, has ascertained that his splendour, when it reaches our earth, is twenty billions of times inferior in intensity to that of the sun. That the sun, therefore, might be made to appear no brighter than Sirius, he would require to be removed from us 141,400 times his actual distance; but

this is scarcely two-thirds of the distance beyond which we know the nearest fixed star to be actually placed. It follows, therefore, that the light of Sirius, and probably also his bulk, is much greater than that of our sun. Dr Wollaston, on data that cannot easily be disputed, has assumed the distance of Sirius to be so great, that his intrinsic light must be nearly equal to *fourteen* suns. Sir John Herschel, taking a more modest and cautious, but perhaps not truer, estimate of his distance, concludes that, "upon the lowest possible computation, the light really thrown out by Sirius, cannot be so little as double that emitted by the sun; or that Sirius must, in point of intrinsic splendour, be at least equal to two suns, and is, in all probability, vastly greater."

I cannot better conclude this paper, than by the judicious remarks with which the eminent philosopher, above quoted, follows up his statements on the size and distances of the fixed stars. "For what purpose," says he, "are we to suppose such magnificent bodies scattered over the abyss of space? Surely not to illuminate *our* nights, which an additional moon, of the thousandth part of the size of our own, would do much better; nor to sparkle as a pageant, void of meaning and reality, and bewilder us among vain conjectures. Useful, it is true, they are to man, as points of exact and permanent reference; but he must have studied astronomy to little purpose, who can suppose man to be the only object of his Creator's care, or who does not see, in the vast and wonderful apparatus around us, provision for other races of animated beings. The planets, as we have seen, derive their light from the sun; but that cannot be the case with the stars. These, doubtless, then, are themselves suns, and may, perhaps, each in its sphere, be the presiding centre, round which other planets, or bodies of which we can form no conception, from any analogy offered by our own system, may be circulating."*

* Herschel's Astronomy, p. 380.

FIFTH WEEK—THURSDAY.

X. THE STARRY HEAVENS.—IMMENSITY OF THE UNIVERSE.

On casting the eye across the heavens, it is arrested by a streak of faint light, which passes athwart the whole sky, in the direction, speaking loosely, of east and west. This streak is called the milky way, in allusion to a well known childish fancy of heathen mythology. When we regard the stars, with reference to this permanent band, we find that, in proportion as they recede from it on either side, they gradually become less and less numerous, till, toward the extreme north and south, there is an obvious deficiency in the comparative richness of the garniture with which the mighty dome is adorned. On applying the telescope to the diffused light of this remarkable part of the heavens, the astronomer is lost in admiration to find that this appearance is occasioned by an amazing multitude of stars, too minute to be detected by the naked eye, and too numerous to be accurately calculated, "scattered by millions, like glittering dust, on the black ground of the general heavens." Sir William Herschel informs us, that, on calculating a portion of the milky way, about ten degrees long, and two and a half broad, he found it to contain 258,000 stars, a quantity so great, in so small a space, that the moon would eclipse 2000 of them at once! Now, all these are suns probably at as great a distance from each other, as our sun is from Sirius,—a distance so incomprehensible, when stated in miles, that the best way of forming some clear idea of it, is to compare it with the velocity of some moving body with which we are acquainted. We know of nothing so swift as light, which moves at the rate of 12,000,000 of miles in a minute; and yet light would be at least three years in passing between the sun and Sirius. Let any one, then, comprehend, if he is able, the dis-

tances implied in the conception, that the minute and thickly-studded sparks of the milky way, are suns, each so far separated from each other, that it would require three years for the light of the one to reach the other! And yet this astonishing view is not a mere gratuitous imagination, but a calm philosophical deduction from observed facts and obvious analogies.

But this stretch of the mental powers is little, compared with what is required for comprehending the conclusions we are led to form, from other celestial phenomena. In various parts of the heavens, and in all quarters, there are discovered either small groups of stars, or certain dusky spots, called nebulæ, which the power of the telescope has multiplied to several hundreds of greater or less distinctness and magnitude. Now, these nebulæ, when subjected to a very strong magnifying power, generally resolve themselves into vast assemblages of minute stars, "crowded together," as Sir John Herschel expresses it, "so as to occupy almost a definite outline, and to run up to a blaze of light in the centre, where their condensation is usually the greatest." "Many of them," adds this astronomer, "are of an exactly round figure, and convey the complete idea of a globular space, filled full of stars, insulated in the heavens, and constituting, in itself, a family or society apart from the rest, and subject only to its own internal laws. It would be a vain task to count the stars in one of these *globular clusters*. They are not to be reckoned by hundreds; and, on a rough calculation, grounded on the apparent intervals between them at the borders (where they are seen not projected on each other), and the angular diameter of the whole group, it would appear that many clusters of this description must contain at least 10,000 or 20,000 stars, compacted and wedged together in a round space, whose angular diameter does not exceed eight or ten minutes; that is to say, in an area not more than a tenth part of that covered by the moon."

Are these numerous spangles, suns like our own, se-

parated from each other by distances similar to those by which our solar star is separated from the other stars of the group to which he belongs? And are we, then, to believe that the system of stars to which our sun belongs, is nothing else than a nebula? And immense as are the bodies which that system embraces, and extensive, beyond all human conception, as is the space which it occupies, must we conclude, that, if viewed from the distance of the other nebulæ of which we have been speaking, it would appear but as a little cloud, no bigger than a man's hand? Such is, in truth, the astonishing conclusion to which the study of celestial appearances seems almost inevitably to conduct us.

Now, if we are permitted, on such a subject, to argue from analogy, we may fancy to ourselves some such idea as this,—that each nebula or group of stars, bears the same reference to other groups which our planetary system does to the globes of which it is composed; and that, while they may be impressed with a rotatory motion round each other, like our satellites round their primaries, there is some central point of unknown position, and immeasurable dimensions, round which the whole groups of the universe revolve, like our little worlds round their sun. There are not wanting reasons for such a supposition, extravagant as it may appear. The two great laws of gravitation and inertia, by which our own system is regulated and maintained, have been proved to exist with precisely the same powers, at least in some of the fixed stars. The probability, therefore, is, that these are universal qualities inherent in all material objects. This, being granted, seems to imply the necessity of a balanced rotatory motion in every system of worlds, for preserving the general equilibrium of the whole; because universal attraction must prevent any body from remaining absolutely stationary. Now, the same principle appears to apply to groups of systems which applies to systems themselves. Hence, we may infer a complication of movements of the most wonderful

and extensive kind, combining not merely worlds with worlds, and systems with systems, but nebulæ with nebulæ, embracing the whole material creation, and extending to infinity. What a magnificent view does this afford of the works of the Eternal; and what a beautiful unity does it appear to give to His operations! Could we but stretch our faculties to the conception, we might figure to ourselves the Almighty present, in some peculiar sense, in the centre of His works, and thence surveying the infinite machine which His hand had formed—groups upon groups, each containing tens of thousands of worlds, moving in constant succession before Him, without confusion, and without interference,—rolling in an ethereal fluid, which bears light and heat in the waves of its never-failing tide, and which communicates life, and intelligence, and joy, to organized existences over the whole,—reflecting, wherever they move, the perfections of an Eternal Mind, and experiencing, throughout all their members, and in all their revolutions, the blessings of a Father's smile.

FIFTH WEEK—FRIDAY.

XI. THE STARRY HEAVENS.—NEBULÆ.

Sir William Herschel, by the use of his powerful telescopes, has made other most interesting discoveries in the starry heavens, some of which it will be the object of this paper briefly to detail, as throwing light on the condition of the universe, and demonstrating that the same mighty hand, which, "ever busy, wheels the rolling spheres" in our own system, is equally employing its amazing powers in the most distant regions, and regulating the material world every where, so far as we are able to discern, by the same laws, under some remarkable varieties of application.

We have already noticed the wonderful discovery of the apparently general arrangement, whereby the innumerable suns, of which the universe is composed, are thrown into groups, each containing vast numbers of these splendid bodies, and comprehending systems of their own. Of these nebulæ, as they are called, our own seems to be of a singular figure, forming a stratum of which the thickness is small in comparison with its length and breadth, and which is divided into two branches, inclined at a small angle to each other, near the point in which our sun, with its planetary system, is situated. This figure seems, at least, to account for the appearances of the heavens, with their milky way, studded with innumerable stars, which branch off in one place in a remarkable manner from the main body, and which, as we have observed, decrease rapidly in numbers, in proportion to their distance from that singular belt. The other nebulæ are of various forms, and even seem to differ from each other in their nature. Sir William Herschel divides them into six classes, of which the two first appear to be distinguished merely by their relative distance from us, but the rest to be in a state altogether different from any thing of which we have experience. These latter, he describes under the four heads of nebulæ, in which there is no appearance whatever of stars, planetary nebulæ, stellar nebulæ, and nebulous stars. Of these the variety is very great, some being formed of little flaky masses, like "wisps of cloud," adhering to small stars; others being of a round or oval form, increasing more or less in density and brightness toward the central point; others offering "the singularly beautiful and striking phenomenon, of a sharp and brilliant star, surrounded by a perfectly circular disc or atmosphere;" others, again, of more rare occurrence, are annular, exhibiting, in the central opening, a faint hazy light; and, last of all, come nebulæ, which have "exactly the appearance of planets,—round, or slightly oval discs, in some instances quite sharply terminated, in others a little

hazy at the borders, and of a light exactly equable, or only a very little mottled, which, in some of them, approaches in vividness to that of actual planets." These last are bodies of enormous magnitude,—so large, indeed, that they would include the whole of our planetary system within their diameter, forming masses of solid matter, if they are solid, such as the greatest stretch of imagination cannot grasp.

"The nebulæ," says the younger Herschel, "furnish, in every point of view, an inexhaustible field of speculation and conjecture. That by far the larger share of them consist of stars, there can be little doubt; and in the interminable range of system upon system, and firmament upon firmament, which we thus catch a glimpse of, the imagination is bewildered and lost. On the other hand, if it be true, as, to say the least, seems extremely probable, that a phosphorescent, or self-luminous matter also exists, disseminated through extensive regions of space, in the manner of a cloud or fog,—now assuming capricious shapes, like actual clouds, drifted by the wind, and now concentrating itself, like a cometic atmosphere, around particular stars;—what, we naturally ask, is the nature and destination of this nebulous matter? Is it absorbed by the stars, in whose neighbourhood it is found, to furnish, by its condensation, their supply of light and heat? Or is it progressively concentrating itself, by the effort of its own gravity, into masses, and so laying the foundation of new sidereal systems, or of insulated stars?"*

The author naively remarks, that it is easier to propound such questions, than to offer any probable reply to them; and it would be well if other astronomers were to imitate the modesty and philosophical forbearance of this eminent man But there are, unfortunately, philosophers, who feel pleasure in every conjecture by which an intelligent First Cause may be excluded from the

* Herschel's Astronomy.

universe; and the obscure and doubtful phenomena afforded by these nebulous appearances, has furnished one of the most profound mathematicians of this class* with a theory, by which he attempts to show, that the whole construction of nature depends on mere unintelligent mechanical powers. He supposes, for example, that our own sun, with his planetary system, was originally nothing else than part of a universally diffused phosphorescent vapour, which, condensing into a nucleus, gave rise to a revolving sun, of excessive heat; that as the heat diminished, the solar atmosphere contracted, leaving portions of itself detached by the centrifugal motion, which became gradually condensed into solid planets and satellites; and these he, with much ingenuity, attempts to show, from mechanical considerations, would assume the form and motions which we find actually impressed on them. Mr Whewell mentions this "nebular hypothesis," as he calls it, and triumphantly shows, that even granting it could account for the phenomena, it could not be held, in the most remote degree, to prove the sufficiency of mechanical causes without intelligence and design. On his highly satisfactory reasoning, we cannot enter, but must refer the reader to the work itself; and we are quite sure that no candid mind can resist the conclusion to which he comes, that, whatever may be the scientific merits of this hypothesis, they cannot, in sound reason, affect at all the view of the universe as the work of a wise and great Creator. "Let it be supposed," observes he in conclusion, "that the point to which this hypothesis leads us, is the ultimate point of physical science; that the farthest glimpse we can obtain of the material universe by our natural faculties, shows it to be occupied by a boundless abyss of luminous matter; still, we ask, how space came to be thus occupied,—how matter came to be thus luminous? If we establish, by physical proofs,

* Laplace.

that the first fact which can be traced in the history of the world is, that 'there was light,' we shall still be led, even by our natural reason, to suppose that, before this could occur, 'God said, let there be light.'"

FIFTH WEEK—SATURDAY.

XII. THE STARRY HEAVENS.—BINARY STARS.

There is yet another singular phenomenon in the starry heavens, which shall form the subject of this day's consideration,—I allude to the curious fact of the existence of binary revolving stars. These are very numerous. Sir William Herschel has enumerated upward of 500, and Professor Strave, of Dorpat, has recently added to this number between 2000 and 3000. When these combinations were first observed, it was thought probable, that their extreme apparent proximity would enable astronomers to ascertain their distance from the earth, by the discovery of an annual parallax; for supposing, as might naturally be expected, that one of the combined stars should be nearer the earth than the other, and that both should prove to be stationary in relation to each other, the motion of the earth in her orbit would cause these stars to alter their apparent position; and, if that should be the case, even in the slightest appreciable degree, this circumstance would furnish data, on which calculations of the greatest importance might be founded. This consideration induced Sir William Herschel to turn his attention to the double stars, and to subject them to careful and minute measurements; but he had scarcely begun this task, when he was arrested by phenomena of a very unexpected character. Instead of the effect which might be produced by the earth's annual motion, he observed, in many instances, a regular progressive change, "in some cases bearing chiefly on their distance; in

others, on their position, and advancing steadily in one direction, so as clearly to indicate either a real motion of the stars themselves, or a general rectilinear motion of the sun and the whole solar system, producing a parallax of a higher order than would arise from the earth's orbital motion, and which might be called systematic parallax."

After a patient investigation of twenty-five years, the elder Herschel ascertained, what has been further established by subsequent observations, "that there exist siderial systems, composed of two stars, revolving about each other in regular orbits." Between fifty and sixty instances of changes in the position of double stars, were adduced by this astronomer, in communications published in the Transactions of the Royal Society for 1803 and 1804. The revolutions of these combinations of stars round each other, are of extremely different periods, one in the Crown being completed in little more than forty years, while that which is found in the Lion, extends to a cycle of no less than 1200 years. Many of the double stars exhibit the curious and beautiful phenomenon of contrasted or complimentary colours. In such instances, the larger star is usually of a ruddy or orange hue, while the smaller one appears blue or green. The complimentary colour of the smaller star may, in some instances, be considered as an optical illusion; but the contrast cannot be thus accounted for in others. The double star in Cassiopeia, for instance, exhibits the beautiful combination of a large white star, and a small one of a rich ruddy purple. Sir John Herschel, in mentioning these combinations, indulges his fancy in the following somewhat amusing remarks:—"It may be easier suggested in words, than conceived in imagination, what variety of illumination *two suns*,—a red and a green, or a yellow and a blue one,—must afford a planet circulating about either; and what charming contrasts and 'grateful vicissitudes,'—a red and a green day, for instance, alternating with a white one, and with darkness,—might

arise from the presence or absence of one or other, or both, above the horizon."*

Without entering into this speculation, which, of course, is taken from the views and tastes of human beings, and may or may not bear reference to the feelings of the animated creation in these distant worlds, I cannot dismiss this curious subject without a single remark on the beautiful variety which appears in the works of the Creator, combined with a sameness which gives evidence of the architecture of One creating hand. The revolving motions of these binary stars have been found to be governed by the same centripetal and centrifugal forces as regulate and preserve the order and harmony of our own planetary system. M. Savary, Professor Encke, and the younger Herschel, having each applied the Newtonian law of gravitation to the calculation of the elliptic orbits of binary stars, have thus elicited their periods, and the form of their ellipses: and the correspondence between their calculated and observed places, has satisfactorily proved the existence of the law in these remote regions of the universe. Here, then, a new element is added to our knowledge of creation. The identity of the light emitted by the fixed stars, and by our own sun, had been previously ascertained, as well as various other particulars which seemed to mark these distant luminaries as belonging to the same universal system; but although, united with these considerations, the phenomena of comets seemed to intimate some connexion between the great laws which govern our own planetary worlds, and those of other suns, and although analogy certainly rendered the extension of these laws to all created things more than probable, it was not till the revolution of these binary stars was observed, and subjected to calculation, that the fact was demonstrated.

It is most curious and instructive to trace the same character in the operations of the Eternal, throughout every corner of His universe, which science unfolds to

* Herschel's Astronomy, p. 395.

our view. It is true, that even now, after all the insight which astronomy has afforded of more distant worlds, it is but a faint glimpse that we obtain; but still that glimpse, while it opens up a profusion of wonders, establishes principles which connect system with system, and group with group; and the gradation and variety which it displays, correspond so remarkably with what we perceive around us, both on the large and the minute scale, that we seem warranted in feeling confidence in our reasonings founded on these analogies, and while we trace every where the exercise of the same power and wisdom, may legitimately infer also, every where, the exercise of the same moral qualities.

SIXTH WEEK—SUNDAY.

DISCOVERIES OF THE TELESCOPE AND MICROSCOPE COMPARED.

The inconceivable space, and innumerable quantities, with which we become conversant in contemplating the phenomena of the heavens, while they stretch the human mind, till it is lost in infinity, are calculated to produce a peculiar effect on our religious views and feelings. They elevate our conceptions of the Creator, and fill us with the utmost astonishment and awe. But there is something so incomprehensible in the attributes of that Self-existent Being, by whose power these wonders were created, and by whose wisdom they are governed, as to overpower and confound the mind. In the presence of such a God, we appear to become as nothing; and, were we only to dwell on the immensities of nature, it seems as if we should scarcely be in a fit state for receiving the truths of Revealed Religion, or for cherishing those pious and filial affections, which the doctrines of the Gospel are so admirably adapted to excite. After wandering through the boundless realms of space, and observing worlds on worlds, and systems on systems, and even groups of systems on groups, in interminable succession, all glorious with the perfections of the Eternal, it is not easy to conceive, that the dreadful and stupendous Power, who created and sustains this infinite universe, should condescend to care for such worms of earth as we are,—much less that he should extend to us the tender affections of a Father. To think of such a Being as providing food for the ravens, and sustaining the sparrow in its flight, or even looking regardfully on man, and numbering the hairs of the hoary head, or counting the beatings of the infant's heart, seems, to the mind thus exclusively prepossessed, as little better than a fond and idle dream. A general Providence, such a mind will readily admit; but,

that the Creator and Sustainer of the universe should occupy Himself with the little affairs of such an insignificant and worthless creature as man, is a doctrine, to say the least, by no means so congenial to the habits of thinking which astronomy induces.

It is not, however, only in the large and magnificent scale of operations, to which the view of the starry heavens introduces us, that the perfections of the Creator are visible. We have seen, that the hand of the Almighty may be equally perceived to be at work in little things as in great. "The cattle on a thousand hills are His."—He not only created them, and endowed them with most wonderful instincts for self-preservation, and faculties for enjoyment; but adapts these instincts and faculties to the revolution of the seasons, and the revolution of the seasons to them. The deeper we examine this subject, the more powerfully are we struck with proofs of the minute and tender care of a Parent in making provision for the wants of His offspring. Descending from the larger to the smaller animals, we find no point in the scale where this parental character stops, or is even diminished. The same wise and most wonderful provision is made for the worm and the mite, as for the lion and the elephant,—their bodies are equally formed with consummate art, and equally contrived with amazing care, for the circumstances in which they are placed, and the means of subsistence and happiness within their reach.

Nor is this all: Science applies its skill to aid nature in investigating the little as well as the great. If, by means of the telescope, the astronomer has been enabled to lay open a thousand wonders of the starry heavens, hid from our unaided sight, and taught us to believe, that, after all, we are only on the threshold of discovery in this department; that we still see, "as through a glass darkly;" and that it is but a faint and feeble glimpse of creation which our most improved instruments can exhibit;—the microscope has directed our attention to wonders no less worthy of admiration on our own earth, and

within our own limited locality, and has informed us that there is a species of infinitude in the minuteness of organized existences, as well as in the magnitude of those which are unorganized; that, in the former, as well as in the latter,—in the myriads of inhabitants in a drop of water, or in the leaf of a plant, or in a grain of sand,—the perfections of the Creator are no less certainly to be seen, than in those mighty suns which, at his command, shed light, and life, and joy, over their attendant worlds, and fill boundless space with His glory.

It is here that the Christian finds an antidote against those doubts which a contemplation of infinite magnitude might otherwise excite in his mind. If it be natural for him to ask, with some feeling of unbelief, "Can the Creator of innumerable worlds look down with pity on the sinful race of Adam? can he be conceived to deal with this race in the way which Scripture unfolds? is it possible that He, the Eternal God, should, in very truth, send His only begotten Son to this little planet, to dwell with men,—taking upon Himself their nature; subjecting Himself to their infirmities; nay, for their sakes, suffering sorrow, torture, and death?"—If, I say, it be natural for the mind, expanded by the philosophy of the heavens, to put these sceptical questions, it can scarcely fail to be brought back to a sounder state, when it takes in a more comprehensive view of the Divine character, and humbly contemplates the very same Hand which moves the universe, preserving the existence, and presiding over the enjoyment, of the microscopic world.

This view is most beautifully and convincingly unfolded by Dr Chalmers, in what have been called his "Astronomical Sermons." By a comparison, in his own characteristic manner, of the discoveries of the microscope with those of the telescope, he shows that we have as much reason, from the works of creation, to conceive of the Creator, as infinitely minute in His providential care, as we have to conceive of Him as infinitely great and

powerful; and, having established this important truth, he leads us irresistibly to the conclusion, that the exhibition made of the Divine Being in His Revealed Word, is in perfect harmony with the character of Himself, which He has impressed on nature.

"They, therefore," says this admirable writer, "who think that God will not put forth such a power, and such a goodness, and such a condescension, in behalf of this world, as are ascribed to Him in the New Testament, because He has so many other worlds to attend to, think of Him as a man. They confine their view to the informations of the telescope, and forget altogether the informations of the other instrument. They only find room, in their minds, for His one attribute, of a large and general superintendence, and keep out of their remembrance the equally impressive proofs we have for His other attribute, of a minute and multiplied attention to all the diversity of operations, where it is He that worketh all in all. And when I think, that, as one of the instruments of philosophy has heightened our every impression of the first of these attributes, so another instrument has no less heightened our impression of the second of them,—then I can no longer resist the conclusion, that it would be a transgression of sound argument, as well as a daring impiety, to draw a limit around the doings of this unsearchable God; and, should a professed revelation from Heaven, tell me of an act of condescension, in behalf of some separate world, so wonderful that angels desired to look into it, and the Eternal Son had to move from his seat of glory to carry it into accomplishment, all I ask is the evidence of such a revelation; for, let it tell me as much as it may of God letting himself down for the benefit of one single province of his dominions, this is no more than I see lying scattered in numberless examples before me, and running through the whole line of my recollections, and meeting me in every walk of observation to which I can betake myself; and, now that the microscope has unveiled the wonders of another region,

I see strewed around me, with a profusion which baffles my every attempt to comprehend it, the evidence that there is no one portion of the universe of God too minute for his notice, nor too humble for the visitation of his care."

I cannot resist the inclination I feel to prolong this quotation, that I may conclude with the following well-known and highly impassioned passage:—"I do not enter at all into the positive evidence for the truth of the Christian Revelation, my single aim, at present, being to dispose of one of the objections which is conceived to stand in the way of it. Let me suppose, then, that this is done to the satisfaction of a philosophical inquirer; and that the evidence is sustained; and that the same mind that is familiarized to all the sublimities of natural science, and has been in the habit of contemplating God in association with all the magnificence which is around him, shall be brought to submit its thoughts to the captivity of the doctrine of Christ. Oh! with what veneration, and gratitude, and wonder, should he look on the descent of Him into this lower world, who made all things, and without whom was not any thing made that was made. What a grandeur does it throw over every step, in the redemption of a fallen world, to think of its being done by Him who unrobed Himself of the glories of so wide a monarchy; and came to this humblest of its provinces, in the disguise of a servant; and took upon Him the form of our degraded species; and let Himself down to sorrows, and to sufferings, and to death, for us. In this love of a dying Saviour to those for whom in agony he poured out his soul, there is a height, and a depth, and a length, and a breadth, more than I can comprehend; and let me never, never, from this moment, neglect so great a salvation, or lose my hold of an atonement made sure by Him who cried, that it was finished, and brought in an everlasting righteousness."*

* Chalmers's Astronomical Sermons, pp. 115-120.

SIXTH WEEK—MONDAY.

WONDERS OF THE MICROSCOPE.—INFUSORY ANIMALCULES.

Having spoken of the wonders of the microscopic world, as a proof that there is nothing too little to be beneath the care of the universal Father, it seems desirable to follow out this statement by an induction of particulars; and I shall devote this paper to that department of animated nature which, on account of its extreme minuteness, escapes the human vision, unless assisted by the resources of art.

The microscope has revealed to human observation new races, and indeed new systems, of organized and living beings, whose existence, had it not been for the invention of that instrument, could have scarcely been suspected, and whose functions must have been entirely unknown. These are the most numerous of all terrestrial creatures, and exhibit properties which fill the mind with a kind of wonder, different from, but scarcely inferior to, that which is excited by the view of nature on the largest scale. Although they are so extremely minute, that a single drop of water may contain hundreds of them, and yet appear to the naked eye as pellucid as if it were a pure and simple globule of newly distilled dew, they are discovered, by the magnifying power of the solar microscope, not only to be animated beings, but to possess members, some of them formed in the most delicate symmetry, and all of them framed with consummate art. Their species are incalculably numerous, each adapted to the element which it occupies, and the peculiar sphere in which it is destined to move. They have obviously volitions, feelings, and preferences, like the superior animals; and, like them, they display symptoms of hatred and affection, of rapacity and contentment, of enjoyment and suffering. Here, then, is a

new world of living beings, sufficiently resembling that in which we are ourselves destined to exist, to prove that it is the work of the very same Creator; yet, as we shall presently see, so different in many respects, besides its extreme minuteness, as to show, still more distinctly, the inexhaustible resources of the Divine Mind, in the endless variety of created existences. The most minute of those animalcules which have been studied and delineated, are the *infusory*, that is, those which are found in liquids; and to these we shall at present confine ourselves. They have been divided into two classes, those with external organs, and those in which such organs are wanting. Of the former, seven genera have been enumerated, and 254 species; of the latter, ten genera, and 123 species. These, it is not to be doubted, form a very small part of the actual existences, many of which are so minute, that they elude the action of the most powerful magnifiers,—as may be safely inferred from the fact, that new species, descending in minuteness, have constantly been discovered, in proportion as the power of the microscope has been increased.

The wonderful diversity of shape in these animalcules, has been thus described:—" Let one suppose himself transported to a region, where the appearance, figure, and motion, of every animal is unknown, and he will form some idea of the variety presented by a drop of an infusion, observed by means of the microscope. One animalcule is a long slender line; another is coiled up like an eel or a serpent; some are circular, elliptical, or globular; others a triangle or a cylinder; some resemble thin flat plates; and some may be compared to a number of articulated reeds; one is like a funnel, and another like a bell; and the structure of many cannot be compared to any object familiar to our senses. Certain animalcula, such as the *Proteus diffluens*, can change their figure at pleasure, being sometimes extended to immoderate length, and then contracted to a point; one moment they are inflated into a sphere, the next completely

flaccid, and then various eminences will project from the surface, altering them apparently into animals entirely different. Neither is the peculiar motion of animalcula less remarkable; in several species, it consists of incessant gyration on the head as a centre, or around a particular point, as if one of the foci of an ellipse; the progression of others is by means of leaps or undulations; some swim with the velocity of an arrow, and the eye can scarcely follow them; some drag their unwieldy bodies along with painful exertion; and others, again, seem to persist in perpetual rest."

In turning to the organs of these microscopic animals, we shall find equal subject for admiration. Some take their food by absorption, being destitute of a mouth; others have a mouth, and several stomachs, amounting, sometimes, to the remarkable number of forty or fifty; some are without eyes, others have several; some have mandibles, and others have processes resembling legs; while many have their mouths fringed with ray-like bristles. In many the internal structure is quite peculiar, in others it bears a remarkable analogy to that of higher species. Each class has its own particular food; some live on vegetable substances, others are predaceous, and others again seem to derive their nourishment entirely from absorbing the liquid in which they exist. *

Let it not be forgotten, that all this minute organization, and these various appetites, habits, and motions, belong to existences too minute, in most instances, to be even discernible by the human eye; and we shall find it almost as difficult to stretch our imagination downward, to the infinitely little among created objects, as it was to rise to the contemplation of the infinitely great. To the minute subdivision of matter, there seems to be no conceivable bounds. This is not very hard to admit; but, to be compelled to believe that the most minute particle which our fancy can frame is an organized and

* Edinburgh Encyclopedia—article Animalcule, written by Dalzell, the Translator of Spallanzani.

living being,—that it has a complex system of members, each of which is most skilfully fitted for its peculiar functions,—that the processes of digestion, of nutrition, and of reproduction, are carried on in these invisible particles with equal perfection as in our own bodies,—that they have instincts, and habits, and powers of choice and of enjoyment,—all this appears so amazing, that the mind can scarcely yield itself to the belief. And, yet, why should it not? All magnitude and quantity are relative. We judge of them merely by the measure of our own experience; and, if we could but sufficiently disengage our minds to take an abstract view, we would perceive that there is, in reality, nothing more incredible in the subdivision and organization of what appears to us infinitely minute, than in the construction of the animals with which our senses are conversant.

Yet what an amazing view is opened up to us, of the Creator, and his infinitely diversified works! The exclamation of Pliny, with regard to insects, may, with peculiar emphasis, be applied to the wonders of the microscopic world:—*In his tam parvis, atque tam nullis, quæ ratio, quanta vis, quam inextricabilis perfectio!* It may be difficult to determine to what extent, or even in what manner, these innumerable myriads of invisible beings produce a salutary effect on the visible world; but we may be sure that it was not without a benevolent object that they were every where scattered over the world. Like the larvæ of certain insects, they probably act the important part of *scavengers*, in removing nuisances from the liquids in which they live, and preserving in them a healthy action. At all events, besides enjoying, as they doubtless do, a kind of happiness in themselves, they furnish food to animals of a somewhat higher species, while these, again, afford support to animals still higher in the scale, and so on, through all the gradations of animated beings,—one species preying upon another, and thus, by a mysterious arrangement, increasing the quantity of living creatures, by an increase of their means of subsist-

ence. It is truly wonderful to observe the wise contrivances by which life is sustained, in all its forms. First, from the crude earth springs the vegetable by which food is elaborated for living creatures; and then follow the countless hosts of invisibles, which prey on these, or their infusions, and on one another; and then, rising through numerous grades, in a thousand different forms, and with continually varying faculties and habits, come the various orders of sentient beings, which fill and adorn the visible creation, deriving their food, like their microscopic fellow creatures, some directly from the vegetable kingdom, others from the bodies of animals which have died a natural death, and others again by the destruction of living creatures. Such is the law of existence, exhibiting the clearest evidence of wise contrivance, but yet marked, in this as well as in other particulars, with the peculiar character belonging to a world blighted with a

SIXTH WEEK—TUESDAY.

I. PLANTS AND ANIMALS COMPARED.

It is my intention now to devote some papers to the consideration of what has been called the *hybernation* of plants and animals; but, before entering on this highly interesting subject, I shall make a few cursory observations on some of the general characters in which vegetable and animal existences resemble each other, and of others in which they differ. Such an examination is not only curious in itself, and satisfactory, as illustrating the remarkable unity of design which exists in creation, but useful to our purpose, as forming a proper introduction to the various particulars which I shall afterward have to investigate.

The first and most important resemblance between

plants and animals, is in their possessing what has been called a living principle. This constitutes the chief difference between organized and unorganized existences; and it is only while it exists in the former, that these exhibit the other qualities by which they are distinguished from brute matter. What this living principle is, it may be impossible to say; but that it is something which possesses distinct properties, and performs peculiar functions, the most ignorant are aware. An animal breathes, and moves, and feels, and performs certain actions for a time: This is animal life. It then ceases to show any of these properties; it lies motionless and insensible; it undergoes rapid decomposition, and is resolved into its original elements: This is death. And something analogous to this takes place in plants. The living principle appears, indeed, under a different and less perfect modification; but still it is there. Although vegetable existences have no voluntary motion, they yet possess certain vital functions; they select and secrete their food; they grow; they expand and flourish. This is vegetable life. After a time, these functions cease; they droop, decay, and are decomposed. Their life is fled.

Both in animals and vegetables, the principle of life is endowed, or at least connected, with a power of repairing injuries to a certain extent, so as to reproduce decayed or destroyed parts. In both, also, there exists a power of reproducing the species. Nor is the similarity less remarkable in regard to a property, the existence of which, in vegetables, was, till lately, but little known,—I mean the circulation of a fluid through every part of the body. That the blood circulated through the veins of animals, was a fact which could never escape observation, although the principle on which this remarkable function depended, was but lately discovered; but it does not seem to have been suspected, till within these few years, that there was an analogous circulation through vegetable substances. That sap existed in plants, in-

deed, was a familiar fact, and even that it was to be found in greater profusion at one season than at another; but it now appears to be satisfactorily ascertained, that there is a regular and periodical circulation of the sap from the root, through the stem of the plant, to the branches, buds, and leaves; and back again through the bark to the root; and that this circulation is as essentially necessary to the life and growth of vegetables, as the circulation of the blood is to the life and growth of animals.

In the manner of propagating the species, too, there are some curious resemblances between the vegetable and animal creation. Besides that the whole classes of plants, like animals, with few exceptions, are divided into male and female, there is another resemblance, which will scarcely be considered fanciful. All the winged tribes, and most of the inhabitants of the sea, as well as amphibious animals, reproduce the species by means of eggs. In like manner, the whole races of plants, from the moss to the tree, with scarcely any exception, propagate their species by means of seeds, which, in many remarkable particulars, deserve the name of vegetable eggs.

Animals seem to differ essentially from the vegetable kingdom, in the possession of sensibility,—a property which the Author of Nature has apparently denied to the latter. This quality forms the first step in the scale, by which the former rises above the latter; but, as it has pleased the Almighty to cause the various grades of existences to run, as it were, into each other, we see here, also, a connecting link of the chain, in the wonderful properties of the sensitive plant, with which most of my readers are probably familiar, which, as it were, simulates sensibility, and approaches so near this vital principle, that authors who delight in those theories which aim at confounding the distinctions that subsist among organized existences, have plausibly maintained the identity of the one with the other.

I have said that plants as well as animals select and secrete their food; but there is a marked difference both in the nature of the food, and in the process by which this nourishment is conveyed and appropriated. The vegetable, adhering to the soil, draws its food from thence, through the medium of roots, by mechanical action, without volition, without feeling, and without locomotion; and that food is inorganic matter. The animal, on the contrary, seeks for its food by a voluntary action, receives it into its system by a mouth, digests it in a stomach, and rejects crudities by an intestinal canal. Its food is organized matter, either animal or vegetable; the Creator having appointed the nourishment of this superior class to be elaborated from crude and indigestible materials by the organized, indeed, but insentient creation below them. This is one of the wonders of that astonishing gradation of beings with which the world is stored, and cannot but be contemplated with admiration and gratitude.

The view which is presented to us, even on the most cursory contemplation of organized matter, as may be perceived from these remarks, is that of a comprehensive whole, united together with the most consummate wisdom, and beautifully harmonizing in all its parts; and this impression will be found to be mightily confirmed and strengthened, when we come to consider the details.

SIXTH WEEK—WEDNESDAY.

II. HYBERNATION OF PLANTS.—ADJUSTMENT OF THE CONSTITUTION OF PLANTS TO THE ANNUAL CYCLE.

From what has been already said, it appears that the chilly nature of the season is not the only cause of the changes in the vegetable kingdom, which begin in au-

tumn, and are consummated in winter. The disappearance of flowers and fruits, the fall of the leaf, and the general sterility which prevails, are evidently the indications of a cycle, belonging to the constitution of this department of nature, which corresponds with the cycle of the year, and affords, by its existence, a new proof of wise adaptation. The effects produced by the sudden occurrence of a tract of frosty and tempestuous weather in summer, compared with a similar occurrence in winter, has been elsewhere alluded to, as illustrative of this principle. But a thousand other illustrations might be given. There is something exceedingly interesting and instructive in this view of the subject. The nice adjustment of organic substances to climate, has already been slightly noticed; and, were this inquiry to be followed out in detail, it could not fail to afford conclusive evidence of the same kind of contrivance with that to which we are now adverting. Every where we should find the productions of the soil admirably adapted to their localities, as to nourishment and climate; and, in the physical distribution of plants, we should discover new grounds for adoring the perfections of the Creator. The most superficial comparison of the plants of tropical regions with those of the polar circle, would be sufficient for this purpose. In the diminutive *Empetrum nigrum*, with its well-flavoured berries, which forms probably the last link of the descending chain of fruits in our progress to the poles, we observe the same careful adaptation of vegetation to the circumstances of external nature, which forces itself on our view in the majestic and luxuriant productions of the equator.

In the extremes of climate, taken on the average, we have, as it were, permanent summer, on the one hand, and permanent winter on the other; but, in the temperate regions, we have a regular alternation of modified heat and cold, which requires a different constitution of the vegetable creation; and that constitution has been bestowed. We here find the gradual development of

seeds, and shooting forth of buds and leaves, in spring; the vigour and prime of vegetation in summer; its maturity, and commencing decay in autumn; its temporary death in winter. Now, what deserves to be peculiarly remarked in this, is the adjusted correspondence of this annual revolution in plants, to the precise circumstances of the character and duration of the seasons.

That the stimulants of heat and cold exercise a considerable influence in promoting or retarding the periodical changes in the vegetable world, there can be no doubt; and this indeed is just one of those wise contrivances which indicate design, as, without this modifying power, a slight variation in the temperature of the season, such as frequently takes place in all countries, and especially in a changeable climate like ours, might be productive of fatal effects: but the influence of heat and cold does not extend beyond a certain range, and is undoubtedly controlled, as we have said, by another principle, which we have called the natural constitution of plants. If proof of this were wanting, we should find it in the fact, that fruit-trees, for example, when transplanted from our northern temperate zone to that of the south, where the seasons are reversed, continue to flourish for several years in the winter months of these regions; and, for the same reason, plants from the Cape of Good Hope, and from Australia, transplanted to our climate, preserve their accustomed period of blooming, notwithstanding the influence of an altered climate. Of this the heaths of those countries which bloom in the most rigorous season of our year, may be taken as a familiar example.

It appears, then, that the functions of plants have a periodical character, entirely independent of heat and cold. Such stimulants could not produce the effects which actually take place, were not the plants formed by the Author of Nature to run their annual cycle. Now, let it be observed, that a year might, by possibility, be of any length. Instead of extending to twelve months,

it might be completed in six, and all the seasons might be comprised in that period, or its revolution might be lengthened to double, or fourfold its present period. In either case, the adjustment which now takes place between the seasons and the constitution of plants, would be entirely destroyed, and an utter derangement of the vegetable world would take place. "The processes of the rising of the sap," says Mr Whewell, "of the formation of proper juices, the unfolding of leaves, the opening of flowers, the fecundation of the fruit, the ripening of the seed, its proper deposition in order for the reproduction of a new plant,—all these operations require a certain portion of time, which could not be compressed into a less space than a year, or at least could not be abbreviated in any very great degree. And, on the other hand, if the winter were greatly longer than it now is, many seeds would not germinate at the return of spring."

"Now, such an adjustment," adds this author, "must surely be accepted as a proof of design exercised in the formation of the world. Why should the solar year be so long, and no longer? Or, this being of such a length, why should the vegetable cycle be exactly of the same length? Can this be chance? And this occurs, be it observed, not in one, or in a few species of plants, but in thousands. Take a small portion only of known species, as the most obviously endowed with this adjustment, and say ten thousand. How should all these organized bodies be constructed for the same period of the year? How should all these machines be wound up, so as to go for the same time? Even allowing that they could bear a year of a month longer or shorter, how do they all come within such limits? No chance could produce such a result; and, if not by chance, how otherwise could such a coincidence occur, than by an intentional adjustment of these two things to one another?—by a selection of such an organization in plants, as would fit them to the earth on which they were to grow; by

an adaptation of construction to conditions; of the scale of the construction to the scale of conditions."*

The concluding paragraph of the chapter from which we have just quoted, which carries the view of adjustment between organized existences and the annual cycle still farther, is also well worthy of being quoted:—"The same kind of argument might be applied to the animal creation. The pairing, nesting, hatching, fledging, and flight of birds, for instance, occupy each its peculiar time of the year; and, together with a proper period of rest, fill up the twelve months. The transformations of most insects have a similar reference to the seasons, their progress and duration. 'In every species, except man,' says a writer† on animals, 'there is a particular period of the year, in which the reproductive system exercises its energies. And the season of love, and the period of gestation are so arranged, that the young ones are produced at the time wherein the conditions of temperature are most suited to the commencement of life.' It is not our business here to settle the details of such provisions, beautiful and striking as they are. But the prevalence of the great law of periodicity in the vital functions of organized beings, will be allowed to have a claim to be considered in its reference to astronomy, when it is seen that their periodical constitution derives its use from the periodical motions of the planets round the sun; and that the duration of such cycles in the existence of plants and animals, has a reference to the arbitrary elements of the solar system,—a reference which we maintain is inexplicable and unintelligible, except by admitting into our conceptions an Intelligent Author alike of the organic and inorganic universe."

* Whewell's Bridgewater Treatise, pp. 28, 29.
† Fleming, Zool. i. 400.

SIXTH WEEK—THURSDAY.

III. HYBERNATION OF PLANTS.—PHYSIOLOGICAL CONDITION OF PLANTS DURING WINTER.

The beautiful variety of shades in our woods and groves, toward the close of autumn, which the most inattentive observer must have admired, arises from the preparation which nature is making for the winter state of our shrubs and trees. The functions of the productive seasons are ended; the forest trees have completed their annual growth; the fruit-bearing trees have yielded their stores; and the leaves, which performed such an important part in these processes, being no longer useful, are to be dropped, that they may, by mingling with their parent earth, supply the waste of the vegetable soil, and repair its exhaustion from the efforts of the preceding year. The sap which had risen profusely in the beginning of autumn, to aid nature in giving maturity to the fruits, and vigour to the young branches, and thus to crown the labours of the year, having performed this important office, has begun to flow downward through the inner integuments of the bark, thus completing its periodical circulation. The leaf and flower-bud, destined to be developed in the ensuing spring, have been already formed, and are carefully shut up in their winter cerements. The tree exposed naked to the wintry blast, is rendered, by a wonderful provision of the All-wise Creator, proof against the injurious effects of frost. It is in its state of hybernation, like many beasts and insects; for here, too, the analogy of nature is striking:—it has fallen into its winter sleep.

The proofs of this state of torpidity are numerous and interesting. Among these, the most familiar is that of the capability of removal, without material injury, to another place. There is no size or age of a tree which

would prevent it from enduring transportation, at this season, without perfect safety, provided only it could be effected without greatly injuring the root; and it is only in winter that such an experiment can be performed with any chance of success. Why? Because the powers of nature are then suspended. The plant has ceased to draw nourishment from the earth, and its vital principle, though by no means extinguished, is in a state of temporary lethargy.

Now, the importance of this state of plants, in winter, will be obvious, if we consider the condition of the soil and climate of temperate regions, during that period. The genial warmth which caused the juices to flow is gone; the ground is frequently rendered, by frost, rigid and almost impenetrable; tempestuous weather would threaten the destruction even of firmly-rooted trees, did not the removal of the leaves admit a free passage to the wind through the branches; the cold would blast the delicate fibre of the growing shoot. All these dangers are either entirely provided against, or at least rendered by no means formidable, by the torpidity which invades the vegetable creation. The plant still lives, but its food is gone; its active operations would expose it to be the sport of the angry elements, and therefore it has retired within itself, like the coiled hedgehog, to sleep out the ungenial season, and to prepare, with new vigour, for the exercise of its renovated powers, in the coming spring.

Much less is known of the physiology of plants, than the interesting nature of the subject would lead us to desire; but there is one circumstance connected with their state in winter, which is too curious to be overlooked. The vital principle, whatever it may be, exerts a peculiar energy in defending them from the influence of frost. A very simple experiment, within the power of every person, will show this. Let a bud be cut off from the parent tree, and suspended, during a strong frost, either by a string, or even within a glass vessel, upon one of the branches, and it will be found that this severed bud

will be completely frozen through, while all the buds still attached to the tree, are entirely unaffected by the cold. There is, then, a living power in plants, which, of itself, resists, to a considerable extent, the effects of cold. But the Author of Nature does not rest the security of vegetable productions on this principle;—on the contrary, the safety of the bud, on which the future existence of the plant so materially depends, is provided for by its careful envelopment in plies of scales, or within a downy substance, besides being often united together by a coat of resinous matter, of which latter state the horse-chestnut furnishes a familiar example. The intention of this kind of protection is distinctly indicated by the fact, that it occurs only in northern countries, the buds of trees in milder regions being destitute of the scaly covering. The security from injury, which the resinous coat affords, may be proved by a simple experiment. Let a bud of this kind be taken from the tree, and, sealing up the cut end, let it be plunged into water; and in this state, it may be kept uninjured for several years. In tropical regions, the leaf or flower not requiring any such means of safety, starts into existence at once, without the intervention of buds,—another proof of the designing hand of Nature in this provision.

We have mentioned the power possessed by plants, in a living state, of resisting the effects of cold; and this fact has led some physiologists to conceive, that an internal heat is generated in plants, as it is in the animal frame. The experiments, however, which have been made to test this opinion, have been of somewhat doubtful result, though some curious facts have been adduced in confirmation of it. It is well known, for example, that snow dissolves more quickly in a meadow than on bare ground; and this has, with apparent force, been attributed to the existence of a certain degree of heat in the vegetation. In certain states of some plants, it has been ascertained, that heat is evolved. M. Hubert relates a striking example of this kind, in the spadices of

a Madagascar plant,—the *Arum cordifolium*. On applying a thermometer to five spadices, which had unfolded in the preceding night, he observed a rise of 25° from the temperature of the atmosphere. The temperature became gradually lower, till, in the evening of the second day, the difference between the heat of the spadices and of the surrounding atmosphere, was only 7°. The observation which we have recorded above, of the power of living buds to resist frost, Willdenow extends to the sap of trees, which, he says, will remain unfrozen in very intense cold. The case, however, is different, as he informs us, in plants of warm and hot regions. The sap of these plants congeals on a very slight cold, and the plants themselves decay; which shows a very remarkable difference between tropical plants and those of colder climates, and strikingly indicates intention. Another observation is, that, although the sap will not congeal in winter, yet, after the buds have been forced out by warm weather in spring, it will readily congeal on exposure to cold,—an effect which Dr Smith ascribes to "the increased susceptibility of the vital principle" at that season. Dead or diseased branches, too, are said to be more liable to be frost-bitten than living and sound ones. These facts, though not conclusive, seem to give probability to the opinion, that the degree of heat necessary to the support of vegetable life, in winter, is maintained by natural processes going on in the plant itself. But, whatever truth there may be in such an opinion, the facts themselves are sufficient to show the impress of an Intelligent Cause, in this, as in every other department of organized matter. We may not be able satisfactorily to trace all the various steps of the process, but we are able confidently to say, Here, too, is the hand of God.

SIXTH WEEK.—FRIDAY.

IV. HYBERNATION OF PLANTS.—THEIR PHYSIOLOGICAL CONDITION CONTINUED.

We have already seen some of the provisions made for the preservation, during this inclement season, of plants of larger growth, which are exposed, leafless, and bare, to all the severity of a chilling atmosphere; and we are now to mention other provisions for a similar purpose, which are no less admirable. One reason, as we have already hinted, why trees of great dimensions throw off their summer clothing of leaves, is, that they may more readily resist the force of the winds, which frequently blow with fury in the winter. But there are some trees which are not endowed with this property; among these, the pine tribe are the most common and conspicuous. Now, remark the contrivances by which the difficulty arising from such a deviation is met. In the first place, the leaves, if they deserve that name, instead of being broad and flat, like those of other trees, are rather in the form of bristles,—which shape suffers the wind to pass freely through, and offers the smallest resistance; and, in the second place, the roots of this class of trees are spread widely along the surface of the earth, laying fast hold of the soil, as they intertwine among each other, and insert their numerous fibres; by which contrivance they are able to stand firm upon their extended base, easily resisting the force of all ordinary tempests. This fact must have struck the mind of any one, who has happened to observe the great breadth of earth and of roots attached to a fir-tree overthrown by some furious storm.

There is a remark, of a more general nature, which occurs here. All trees are known to attach their roots to the soil, with more or less tenacity, in proportion to their

exposure to the wind. There is nothing more familiar to the wood-forester than this striking fact, or more necessary for him to know. The trees, on the outside of a grove or wood of pine, are so firmly fixed in the soil, that scarcely any tempest can uproot them; and these shelter the rest, whose hold is not so secure. Were this outer ring to be cut down, the wind, thus suddenly let in, would be sure to injure the rest, and the safety of the whole wood might be endangered. Here we find an instance of adaptation to circumstances, which cannot be too much admired.

Other kinds of evergreens, which enliven the winter months, are to be found among shrubs, and some of the lower species of trees. These are more able to resist the fury of violent winds, on account of their diminutive height, which exposes a shorter, and therefore less powerful, lever to the action of this force, while their roots are equally adapted, with those of the pine, to the peculiarities of their nature. Besides this, the leaves of these hardy plants are generally of a solid texture, and glossy surface, well suited to resist the various vicissitudes of the season. Such delightful varieties seem to have been bestowed on us, for the purpose of affording relief from the stern aspect of winter; and the grounds of the rich show how well a judicious use of these, and of various herbaceous plants, can throw, over the bleakness of this gloomy season, some of the charms of summer.

If, from shrubs and trees, we turn to the numerous and useful classes of herbs, we shall find ourselves introduced into a new field of wonders. Some of these only survive till they have shed their seed in autumn; and, having thus provided for the propagation of their species, perish as individuals, and mingle with their parent earth,—resembling, in this respect, many species of insects. But others survive the winter; and of these, many die down to the root, and thus, like numerous animals, burrow, as it were, underground, where, in vir-

tue of their combined torpidity and vital energy, they remain secure from the attacks of frost, even when it penetrates to their retreats. Here some of them are secretly preparing, by mysterious internal processes, for the coming spring; while others appear to lie entirely dormant, till more genial weather awake them from their deep sleep. Again, other classes of herbaceous plants continue to breathe the rigours of winter, cheering our otherwise desolate gardens and fields with their languid smile, and expanding their blossoms, or stretching their green leaves from soil bound in the iron fetters of ice, or covered with a cold but bright mantle of snow. Of those species which survive the winter, some are biennial, and others perennial; and of the former species, it has been remarked, that, though their life may be prolonged by transplanting them, and thus retarding the period of flowering and bearing seed, yet no artificial means can prevent their decay, after they have provided for the future propagation of their species, by exercising this important function.

Cowper, with his usual piety and felicity, adverts to these paternal provisions of the God of the seasons :—

"He marks the bounds which Winter may not pass,
And blunts his pointed fury; in its case,
Russet and rude, folds up the tender germ
Uninjured, with inimitable art;
And, ere one flowery season fades and dies,
Designs the blooming wonders of the next."

Before closing this paper, we may just hint at another remarkable provision of Nature, with regard to plants, as applicable to the present season of the year,—that, by which the vegetable principle acquires a kind of accelerated impulse, by being pent up for a more than ordinary period. Every one is familiar with the fact, that a cold spring retards the vegetation; and that, when this has been the case to a more than ordinary extent, a few days of warm weather succeeding, will cause a sudden and

wonderful burst of vegetation, which soon compensates for the delay. Nature is in haste, as it were, to regain her lost time. This principle is peculiarly remarkable in very northern climates. Where the snow lies on the ground more than ten months of the year, as in Siberia and Lapland, spring, summer, and autumn, are all comprised in the short space of four or five weeks; and, during that period, the whole process of springing, growing, flowering, producing fruit, and ripening, is comprised. This is exemplified in a register kept of the Siberian vegetation, of which the following is a copy :—

July	1.	Snow gone.
	9.	Fields quite green.
	17.	Plants at full growth.
	25.	Ditto in flower.
August	2.	Fruit ripe.
	18.	Snow.

And from that time, snow and ice to 23d June, when they begin to melt.

This astonishing elasticity in the principle of vegetable life, is an exceedingly striking provision of the God of Nature, which indicates adaptation to a very peculiar state of climate, that cannot be sufficiently admired. Where Nature sleeps for five-sixths of the year, the plants sleep during the same period; and yet, when they awake, they run their course, like other plants, only hastening their pace, that they may accomplish it within the allotted time.

SIXTH WEEK—SATURDAY.

INSTINCT.

In proceeding from examining the state of plants during winter, to the consideration of that of animals, the

subject of Instinct forces itself on our attention. This is one of the most mysterious and wonderful of all the qualities inherent in organized beings, and, in its operations, exhibits so distinctly a Designing Cause, separate from the being which possesses it, as to be calculated, more perhaps than almost any other phenomenon, to carry to the inquiring mind a settled conviction of a supreme and intelligent Creator.

Instinct has been defined to be "the operation of the principle of organized life, by the exercise of certain natural powers, directed to the present or future good of the individual;" and it has been distinguished from reason, by considering the latter as "the operation of the principle of intellectual life, by the exercise of certain acquired powers, directed to the same end."* This definition, without entering into the theory with which it is connected, seems sufficiently accurate to answer our present object.

Symptoms of an instinctive principle, as thus defined, are to be found in various productions of the vegetable world. Two or three instances of this kind may be mentioned:—

A strawberry offset, planted in a patch of sand, will send forth almost the whole of its runners in the direction in which the proper soil lies nearest.

When a tree, which requires much moisture, has been planted in a dry soil, in the vicinity of water, it has been observed, that much the greater proportion of its roots have been directed toward the water.

Trees which have sprung up on a bare rock, will send out their roots in every direction, till they reach the soil below. Every one is familar with this fact, who has frequented a wooded rocky district.

A fact of a similar nature, which is noticed, I think, by Lord Kames, and which I have myself witnessed, occurred at the Abbey of Sweetheart, in Galloway, where an ash-tree, growing on the wall which surrounds the

* Good's "Book of Nature," vol. ii. p. 141.

abbey, after exhausting the small quantity of soil which had collected on its site, stopped from growing for a time, and seemed to unite all its strength in sending down a root to the ground. As soon as this root had established itself in the soil, the tree began again to flourish and increase, till it grew to a considerable size.

I have somewhere seen an account of a tree, which grew in the valley of the Earn, in Perthshire, if I mistake not, on a scanty soil, by the bank of a stream, over which, in its immediate vicinity, a foot-bridge, covered with turf, had been erected. The tree, taking advantage of this circumstance, pushed its roots through the dead turf of the bridge, till they fastened in the fertile soil, which happened to lie on the other side of the stream; and then, swelling and strengthening its new organ of communication, drew sufficient nourishment from this source to supply all the wants of its nature.

All facts of this kind, and many more might be mentioned, may, in my opinion, be clearly attributed to the principle of instinct.

Of instinct in animals, Dr Good gives the following curious notices:—"All the different species of birds, in constructing their nests, not only adhere to a peculiar plan, but, whenever they can obtain them, to peculiar kinds of materials; but, if these materials be not to be procured, the accommodating power of the instinctive principle directs them to others, and suggests the best substitutes. Thus, the redbreast, uniformly prefers oak leaves as a lining of her nest, wherever she can acquire them; but, if these be not to be had, she supplies the want by moss and hair. So, when the bird is of a small size, and the eggs are naturally numerous, the nest is always made proportionally warm, that the nestlings may all equally partake of the vivifying heat. Thus, the wren, who lays from ten to eighteen eggs, constructs her little edifice with the greatest care, and of the warmest materials; while the plover and the eagle, whose eggs are so few, that the body may easily cover them, build

with little solicitude, and sometimes content themselves with the naked cleft of a rock. And thus, too, in very cold winters in Lapland, the fond water-fowl will occasionally strip the down off its breast, to line its nest and protect its progeny. When a wasp, in attempting to transport a dead companion from the nest, finds the load too heavy, he cuts off its head, and carries it out in two portions."

These illustrations may suffice for the present, especially as by far the greater part of the facts relative to the animal creation, which I am about to adduce, must be referred to the same principle. Instinct, I may add, as in some of the above instances, does not unfrequently resemble reason, and it may be united with, and modified by, this quality; but it may always be distinguished from it by this, that its operations are generally perfect of their kind; that its powers are precisely the same in all generations; that they belong, nearly in an equal degree, to all individuals of the same species; and that its functions proceed blindly toward the attainment of an important object, the use and tendency of which is not perceived by the creature itself.

I have said, that this principle is probably calculated, better than any other natural phenomenon, to lead the mind to an acknowledgment of a Divine hand. Let us revert, for a few moments, to this view.

In examining the general structure of the universe, we observe a few simple, though vast and comprehensive, powers inherent in matter, which, by their universal and uniform operation, move Nature with the same regularity as if it were a mighty machine impelled by brute force; and hence the indolent or sceptical may be inclined to rest in the existence of these powers as an ultimate fact, without seeking for an intelligent Creator, from whom they emanated, and by whom they have been adjusted and regulated. The same thing may take place in contemplating the structure of organized bodies. So much of mere mechanical power enters into every process of

their formation, growth, and preservation, that, although it does seem to be the blindness of utter stupidity to deny to these productions unequivocal marks of wise and beneficent design, it is possible to conceive, that, in tracing the mere physical laws by which their various properties are governed, the cold calculations of a contracted mind may proceed no farther. On turning from these appearances of external nature, to the operations of rational creatures, such minds may be led to admire the wisdom which contrives, and the power and skill which executes, the various plans of life, without directing one serious thought beyond the intelligence of the immediate agent. But it requires a still greater degree of obtuseness and of obstinacy, to resist the evidence of a designing and bountiful Creator, in the wonders of instinct. These are altogether independent of reasoning powers, and impel organized beings by a sagacity, obviously not their own, to compass important ends, which, though essential to the welfare, and even to the very existence, not only of the individual, but of the species, could not, by any possibility, be within their contemplation, being far beyond the range of their limited faculties. Here, then, there is a designing cause, distinct from, and superior to, the agent; and this is the more clearly discernible, because its operations are governed by other than mere mechanical powers. "I look upon instinct," says Addison, "as upon the principle of gravitation in bodies, which is not to be explained by any known qualities inherent in the bodies themselves, nor upon any laws of mechanism; but, according to the best notions of the greatest philosophers, is an immediate impression from the First Mover, and the Divine energy acting in the creatures; such an operation of the Supreme Being as that which determines all the portions of matter to their proper centre."

SEVENTH WEEK.—SUNDAY.

ON SEEING GOD IN HIS WORKS.

Almost all men, not in the lowest stage of barbarism or degradation, are capable of admiring the beauties of Nature. Even the dullest and most unreflecting mind is, at times, more or less vividly impressed with the wonderful skill and beauty so profusely scattered over all creation. But the intelligent eye is always delighted, and frequently kindled into rapture, by the rich and splendid scenery that on every side solicits its attention. Our susceptibility of impressions of grandeur or beauty, deserves to be ranked among our original faculties; for it is observable in all classes of the human family,—refined and exalted in the bosom of the enlightened European, and not unfelt by the savage tenant of the African or American desert. A love of nature appears to be implanted in man, to feed the flame of religion in his soul,—to assist in leading him from the wonderfully contrived objects around him to a belief in an intelligent and bountiful Creator. We are told, in Holy Scripture, that God never left himself without a witness to the human race, inasmuch as his power and goodness may be always clearly known from the exuberant plenty and beauty scattered over the earth, their magnificent abode. As they had hearts to feel a sentiment of gratitude for bounty lavishly bestowed, and understandings to reason from effects to causes, the ancient heathen were altogether inexcusable in not knowing the true God, the great First Cause of all, and the source of "every good and perfect gift." They wandered from the right way, only because they were heedless or wilfully perverse. Their feelings and powers became the instruments of their self-delusion; and, instead of seeing in nature a supreme and infinite God, they saw a thousand grovel-

ling divinities; and fancy lent all the fascinations of poetry to the corrupt and irrational mythology.

But if the heathen, who lived in times of rudeness and ignorance, were subject to condemnation for abusing their faculties and opportunities, how much more guilty are we in not seeing God in all his works. How much more worthy of punishment are we, if we turn not into their proper and legitimate channel that sympathy with external nature, and that instinctive admiration of the grand and the beautiful, with which we are endowed. The question is not,—do we, like the heathen of ancient or modern times,—believe in a polytheism, and people, with the vain creatures of our imagination, the regions of the land and the sea; for we at once, unintelligently, perhaps, and, as it were, mechanically, assent to the received truth,—There is one God; and we also readily acquiesce in the grave lessons that may be read us by some pious student of the book of Nature. But the inquiry to be made at our own hearts is, Do we *habitually* see the Creator in His works, and associate His glorious perfections with every witnessed specimen of His skill? We luxuriate in the glowing summer landscape; we there admire the universal flush of inanimate nature; we listen, with delight, to the sweet singing of birds, and the mingling murmurs of winds and streams: But do we straightway lift up our eyes to heaven in adoring gratitude, and own a God around us? or do all our feelings but minister to a luxurious sensibility, and evaporate in some poetic dream? When we survey, by night, the starry heaven, and direct our telescope to those countless worlds that there crowd upon the vision, are we lost in devout admiration of the wondrous universe of God? or do we merely resign ourselves to those emotions of sublimity that such a magnificent scene is so well fitted to awaken? We are too apt, and too habituated to behold the glories of creation, without looking further. We are satisfied with a vague sentimental feeling of beauty, and think not of that Hand from

which all beauty flows. We are struck with the endless adaptations of the material world, but we do not always raise our thoughts to the great Designer. We analyze and admire the splendid machinery of the heavens, but we recognize not the matchless power of the Mechanist. We philosophize, we speculate, we declaim, on the structure of a flower, or the mechanism of a planetary system, but only talk the while of *Nature* and her works, as if Nature—a mere fashioned mass of inert matter—were the parent of all things, and the grand object of our worship.

Would we read the book of Nature aright, and see God in his works, we must have recourse to the book of Revelation; for these two great volumes, written by the same hand, and for a similar purpose, cast a strong light upon each other. As the book of Nature, by the visible impress of Divinity stamped upon it, is fitted to prepare us for the more glorious display of the Divine perfections contained in the book of Revelation,—so is this latter the truest and safest guide to the profitable perusal of the former. In the Bible, the great productions and aspects of nature are always mentioned in connexion with the glory of God. They are introduced, often in strains of the boldest poetry, to teach the infinite power and goodness of Jehovah. We there find the noblest descriptions of natural objects ever penned; and one great moral runs through them all. Every masterly picture of the grand or the beautiful in nature, is but a delineation of God's wondrous attributes.

It is, therefore, a positive duty, sublimely taught us both by precept and example, to cherish a sense of the Infinite skill and bounty displayed in the creation. We should associate, with all that attracts the eye by its beauty, or excites our admiration by its delicate structure, the liveliest expressions of adoration and gratitude. Every survey of natural scenery, every examination of even the smallest of God's works, should be to us a devotional exercise. To a mind accustomed to consecrate

all its perceptions of beauty and design to the inward worship of God, every mountain and field, every leaf and flower, teems with instruction. The tiny wing of the ephemeral insect, as well as the noblest animal form, affords food for the loftiest admiration. The man of true piety and refined feeling, enjoys the beauties of nature with the keenest relish; for nature is but a pictured volume, in which he reads the character of the Divinity. Every object that meets his eye, be it vast or minute, simple or complex, suggests the most exalted conceptions of Him

> "Who gives its lustre to an insect's wing,
> And wheels His throne upon the rolling worlds."

All our feelings and intellectual powers should be devoted to the glory of God, their Author and their End. Our purest sympathies, our liveliest sensations, our most exquisite perceptions, are due to His worship, and are all originally fitted to exalt our conception of His character. To behold the wonderful scene in which we are placed with the eye of reason, and with feelings of elevated devotion, is both our duty and our privilege. When we contemplate, therefore, the heavens with the sun, moon, and stars, which God has ordained,—the earth, with all its array of plants, and flowers, and animated beings,—the sea, with its multitude of waves and living forms, let us gratefully adore the Almighty Creator, and exclaim with the psalmist, "O Lord, our Lord, how excellent is thy name in all the earth!"

J. D.

SEVENTH WEEK—MONDAY.

REASON IN THE LOWER ANIMALS.

Instinct, if the definition which I have given of it in my paper of Saturday be correct, will not account for all the operations of the lower animals. Instinct is uniform.

It belongs to all the species nearly in the same degree. The young possess it as soon as they are produced; or, at least, as soon as their bodily powers will enable them to employ it, in as great perfection as the old. It is not communicated by instruction; it is not learned by experience. The young bee, for instance, the moment it leaves the cell where it has been produced and cradled, cleans its body, smooths its wings, then leaves its hive, and flies, without a guide or teacher, to the nearest flower, where, using its feelers, and inserting its proboscis, it sips the sweet nectar with which the Author of Nature has, for its use, filled so many vegetable cups, and then returns to its native roof, tracing its solitary way through the trackless air, and deposits the gleanings of its industry, to add to the hoarded treasures of the parent swarm. Then, again, it exudes the secreted wax from the rings of its body; and, still without instruction, begins to form those wonderful hexagonal cells, the scientific construction of which the mathematician has found such reason to admire. All this is instinct.

Yet, though there is wisdom here, it is not that of the animal, but of its Creator. It has been guided to these intelligent works by a blind impulse. This, however, is not the case with many of the actions of the inferior creation; and, however difficult it may be to draw the line between reason and instinct, I believe no person who has, without prejudice, studied the character and habits of the living creatures below him, will find it easy to deny them at least some glimpses of that higher faculty to which his own species has the most appropriate claim. A few well authenticated instances will illustrate this remark.

I have the following anecdote from a gentleman* of undoubted veracity, and acute observation, in the vicinity of Dumfries. A few years ago this gentleman had beautified his residence, by converting a morass in its neighbourhood into an extensive piece of water, which he had

* James Lennox, Esq. of Dalscairth.

stocked with fish; and, as places of retreat for these tenants of his lake, he had caused numerous roots of trees to be thrown in here and there, which were usually hid below the surface. This year (1836), however, the unusually dry spring caused the necessary supply of water unexpectedly to fail, and the pond sank so low, that some of the roots made their appearance, and on one of these, more elevated than the others, a pair of wild ducks constructed their inartificial nest, and the female had already laid some eggs, when the weather changed, and the descending rains having filled the streams by which the lake was fed, the surface gradually rose, and threatened to overwhelm the labours of this luckless pair, and to send their eggs adrift on the swelling waves. Here instinct had no resource. It was an unexpected occurrence, for which this faculty could not provide; but if any glimmerings of reason belonged to these fond parents, it might be expected to be exerted. And so it was. Both the duck and the drake were observed to be busily employed in collecting and depositing materials; presently the nest, which the rising waters had already reached, was seen to emerge as it were from the flood; more and more straw and grass were added, till several inches of new elevation was gained, and the nest, with its precious contents, appeared to be secure. Here the fond mother patiently brooded her full time; and one duckling rewarded her care; when, just as it had escaped from the shell, another torrent of rain fell, more sudden and more violent than the first; the water rose higher and higher; the nest, and remaining eggs, were swept away. In this emergency, the whole attention of the parents was given to the living progeny, which was safely conveyed by them to the shore, where another nest was constructed; and their sagacity and solicitude were finally crowned with success.

An example of a still higher order of intelligence is recorded by Mr Jesse, in his "Gleanings in Natural History," which came under his own observation:—" I

was one day," says he, "feeding the poor elephant (who was so barbarously put to death at Exeter Change) with potatoes, which he took out of my hand. One of them, a round one, fell on the floor, just out of the reach of his proboscis. He leaned against his wooden bar, put out his trunk, and could just touch the potato, but could not pick it up. After several ineffectual efforts, he at last *blew* the potato against the opposite wall, with sufficient force to make it rebound; and he then, without difficulty, secured it." If we can believe that this extraordinary action was any thing but an ebullition of anger which led him to puff away the root which he could not secure,—that this half-reasoning animal, as the elephant has been called, really intended the potato to rebound within his reach, it is impossible to deny the justice of Mr Jesse's conclusion, that it could not be instinct which taught him to procure his food in this manner; and that it must, therefore, have been reason which "enabled him to be so good a judge of cause and effect."

In some of the insect tribes, there seems to be an extraordinary faculty, which, if it can be called instinct, surely approaches to the highest faculty possessed by man,—I mean the power of communicating information by some natural language. Huber affirms, "that nature has given to ants a language of communication, by the contact of their antennæ; and that, with these organs, they are enabled to render mutual assistance in their labours and in their dangers, discover again their route when they have lost it, and make each other acquainted with their necessities." This power seems to be confirmed by what occurred to Dr Franklin. Upon discovering a number of ants regaling themselves with some treacle in one of his cupboards, he put them to the rout, and then suspended the pot of treacle by a string from the ceiling. He imagined that he had put the whole army to flight, but was surprised to see a single ant quit the pot, climb up the string, cross the ceiling, and regain

its nest. In less than half an hour, several of its companions sallied forth, traversed the ceiling, and reached the repository, which they constantly revisited, till the treacle was consumed. The same power of communication belongs also to bees and wasps; as may be proved by any one who carefully attends to their habits. This is their language, not of articulate sounds, indeed, but of signs,—a language which, as Jesse observes, "we can have no doubt is perfectly suited to them,—adding, we know not how much, to their happiness and enjoyments, and furnishing another proof that there is a God all-mighty, all-wise, and all-good, who has 'ornamented the universe' with so many objects of delightful contemplation, that we may see Him in all His works, and learn, not only to fear Him for his power, but to love Him for the care which He takes of us, and of all His created beings." Whether this power of communication be rational or instinctive, it is obviously only suited to be useful to a being possessed, at least to a certain extent, of intellectual faculties,—of the power of forming designs,—of combining, with others, to execute them,—of accommodating itself to circumstances, and, therefore, of remembering, of comparing, of judging, and of resolving. These are assuredly acts of reasoning; at least I know not under what other category to arrange them.

The instance which Dr Darwin gives of a wasp, noticed by himself, is in point. As he was walking one day in his garden, he perceived a wasp upon the gravel walk, with a large fly, nearly as big as itself, which it had caught. Kneeling down, he distinctly saw it cut off the head and abdomen, and then, taking up with its feet the trunk, or middle portion of the body, to which the wings remained attached, fly away; but a breeze of wind, acting on the wings of the fly, turned round the wasp, with its burden, and impeded its progress. Upon this, it alighted again on the gravel walk, deliberately sawed off, first one wing, and then another, and having thus

removed the cause of its embarrassment, flew off with its booty.

Here we have contrivance, and re-contrivance; a resolution accommodated to the case, judiciously formed and executed, and, on the discovery of a new impediment, a new plan adopted, by which final success was obtained. There is, undoubtedly, something more than instinct in all this. And yet we call the wasp a despicable and hateful insect!

There is, I am well aware, a great reluctance in some minds, to admit that any of the lower animals can be gifted with a faculty superior to blind unreasoning instinct. It is imagined that this would be to confound man with the brutes, and thus to deprive him of that distinctive superiority on which he founds his strongest argument for the immortality of the human soul. Of such a consequence I have no fear. It is not on natural arguments that the Christian's hope of future happiness is founded, but on that gospel, which has "brought life and immortality to light." Still, I freely admit, that the argument from natural religion is satisfactory as a proof of the coincidence of revelation with the rational expectations, and the analogical reasonings of man. But these expectations and reasonings are founded on stronger grounds than that of the absence of every thing approaching to reason among the lower animals, otherwise, I fear, they could not be readily sustained. Whatever may be their strength, however, it is delightful to know that our assurance comes from a higher source, and that we are not reduced, like one of the most enlightened and virtuous of heathens, to end all our anxious arguments on this most important subject, with the feeble and doubting conclusion, "*Quod, si in hoc erro, libenter erro.*"*

* Cicero.

SEVENTH WEEK—TUESDAY.

HYBERNATION OF INSECTS.—EGGS.

In attending to the state of animated nature in winter, as compared with that of summer, few things are more striking than the almost total disappearance, during the former season, of all the insect tribes. In the warmth and sunshine of the summer months, all nature was instinct with life; and the abundance and variety of the more minute animals, could not fail to attract the observation, and excite the wonder, of all who have eyes to see. The bee, the dragon-fly, the butterfly, the gnat, and the midge, in all their varieties, with myriads of flies of other species, seemed to communicate life and enjoyment to the very air we breathe; while the worm, the beetle, the ant, the caterpillar, the spider, and innumerable other creatures, some of them too minute to be examined without the assistance of art, swarmed on every flower we plucked, and animated the very dust beneath our feet. Where now is all this busy world? Tribe after tribe, they have vanished from our view; and even in days of balmiest air, and brightest sunshine, we seek for them in vain. Has the breath of winter pierced through their tiny forms, and frozen the current of life at its source? And, if so, by what process of reproduction shall all their various species be reanimated in the returning spring? The inquiry is at once interesting and useful; and here, again, we shall have occasion to admire the inexhaustible resources of Divine intelligence.

Of some insect families, it is known, that all the individuals are destined to perish before the cold of winter arrives. The natural term of their existence is comprised within the span of a few months; and their periods of youth, of vigour, and of decay, nay, of resus-

citation under new forms, and of the various stages of their second or even third state of existence, have all been accomplished during the season of genial warmth; so that they naturally cease to exist before the heat which cherished them, and the food which sustained them, are withdrawn. Their modes of life will more properly form the subject of attention at another season; but at present we have to inquire into the provision of Providence, by which the various species are preserved after the whole race have ceased to live.

As the principle of equivocal generation is nearly exploded from natural history, it will readily be conjectured that the Creator must have provided for the preservation of the future generations of these animals by means of their eggs; and this, in reality, is the case. There are various conditions, however, that require to be fulfilled before this could be successfully accomplished. Not to advert, at present, to the wonderful but familiar contrivance, of an egg containing the embryo of the future animal, a contrivance which shall afterward be considered, it is to be remarked that, in the present instance, the egg must be endued with the quality of preserving its principle of vitality for several months, in circumstances which would have proved fatal to the animal itself; that it must only produce the living creature when the wintry storms are past, and when those vegetable substances have begun to appear on which that creature can subsist; and, that it must be so situated, and so endowed, as to be able, when animated, to find its way to the open air, and to its natural food. If any one of these conditions were wanting, it is sufficiently apparent that the species must perish.

Now, let us take an instance, and see what actually occurs. I select the case of the gipsey-moth, which I abridge from the article Insect Transformations, in the "Library of Entertaining Knowledge." The female of this insect has her body thickly covered with a soft down, of a hair-brown colour, apparently for the express purpose

of enabling her to protect her eggs during winter; and she follows the impulse of her nature, in a manner well worthy of notice. Having emerged from her pupa-case in the month of August, she enjoys life for a few days, and then prepares for the propagation of her species, after which she quickly dies. She places herself on the trunk of an oak or elm, invariably with her head downward. Having made a bed or nest of down, by tearing it from her body, she lays an egg in it; and this egg being covered with adhesive gluten, attaches around it all the hairs of the down with which it comes in contact, and also sticks to the bark of the tree, from its being pushed home. Proceeding in this manner, she continues for several hours adding to the mass; but she does not, in general, finish the operation in less than two days, indulging in occasional rests. At intervals, she takes care to protect the eggs placed in the heap, which is made in a conical shape, with an exterior covering of the same down; and, it is not a little remarkable, that in the external coping, which is designed to keep out the winter rains, the hairs are carefully placed in a sloping direction, like the tiles on a house, or the pile of a well-brushed hat, pointing downward, toward the base of the cone. The eggs, which are deposited with so much care, are destined to abide all the pitiless pelting of the storms of winter; for, although they are laid in the beginning of harvest, they are not hatched till the elm, which is to furnish food to the future caterpillar, comes into leaf in the following spring. This covering of down, from the manner in which it is tiled and brushed smooth by the mother moth, not only protects them from wet, but, being one of the best non-conductors, keeps them safe from the injury which they might sustain from severe cold, or what might be more fatal, from sudden alternations of heat and cold.

In the instance now detailed, there are some things worthy of particular notice; and, as it is a fair specimen of the wonderful instincts of insects with reference to

the preservation of the species during winter, it may be proper to make a few remarks on the subject. Let it be observed, first, that in the previous states of the insect, whether as a caterpillar or a chrysalis, it had no power of propagating its species. It is not till its last and most perfect stage that this faculty is bestowed; and it enters on that stage just in time to flutter awhile in the sunshine, and then to die before the cold of the waning year interrupts its enjoyments, withers the vegetables on which it feeds, and chills its delicate frame; and in time, too, to lay its eggs, that they may weather the coming storms of winter, which the parent could not endure, and be hatched when the breezes of spring begin to breathe softly, and nature again proceeds to scatter her stores of food. It cannot be here said, either that the insect dies from the inclemency of the season, or that the hatching of the eggs is retarded by the deficiency of warmth; for the season is still genial, when the former, having fulfilled the intentions of nature, ceases to exist, and months of weather not inferior to the heat of spring, succeed the depositing of the latter. It is no other than a wise Providential arrangement.

Another surprising feature of the instinct displayed by this moth (which, however, so far from being peculiar to the species, is only an instance of a general faculty affecting almost the whole insect creation), is the choice of the spot where she deposits her eggs. Her eggs, when hatched, are destined to produce caterpillars, whose peculiar food is to be found in the leaves of the oak or elm. From all the trees of the forest, she, therefore, selects one or other of these as the place for depositing her precious gift to a future year, although it is not from them that her own means of subsistence are to be gathered; and, although, so far as we are able to judge, there is nothing in her condition, as a moth, which could lead to the preference.

We have already spoken of the remarkable manner in which the gipsey-moth protects her eggs from the wea-

ther; but it may be proper to make an observation or two on the eggs themselves, applicable generally to all insect eggs, which are exposed to the storms of winter. The glutinous matter by which the eggs are united, when protruded from the insect, and which is so necessary for preserving them in a mass, and for fixing them to the spot, is found, contrary to the nature of many similar substances, to be insoluble in water, and therefore incapable of being affected by the copious rains to which they are destined to be exposed. But this is not so remarkable as another fact, which has been proved by some severe tests, and which shows how admirably the constitution of these eggs is adapted to the season of winter. Both Spallanzani and Hunter made experiments to ascertain the degree of cold which the eggs of insects were capable of enduring without injury; and we subjoin the statement of the latter:—"I have exposed eggs to a more rigorous trial than the winter of 1709.* Those of several insects, and, among others, the silk-worm, moth, and elm-butterfly, were inclosed in a glass vessel, and buried five hours in a mixture of ice and sal gum *(rock salt)*. The thermometer fell 6° below zero. In the middle of the following spring, however, caterpillars came from all the eggs, and at the same time as from those which had suffered no cold. In the following year I submitted them to an experiment still more hazardous. A mixture of ice and sal gum, with the fuming spirit of nitre *(nitrate of ammonia)*, reduced the thermometer 22° below zero,—that is, 21° lower than the cold of 1709. They were not injured, as I had evident proof, by their being hatched."

It is, indeed, a singular and unaccountable fact, that the eggs of these insects are incapable of being frozen even by the intense cold now mentioned. Spallanzani discovered this, by crushing some of them with the nail,

* The year 1709 is celebrated for its rigour, and its fatal effects on plants and animals Fahrenheit's thermometer fell to one degree below zero, and yet the insects were as numerous in spring as ever.

when he found that their contents remained fluid; and he justly infers, that the included embryos remain equally unfrozen. The final cause of this is easily understood; but the chemical property which resists so severe a trial, has not been ascertained.

The modes by which instinct has taught insects to preserve their eggs during winter, are very various. One of these I have already detailed; but, before leaving the subject, there is another which, on account of its singularity, I cannot deny myself the pleasure of mentioning; I allude to the cochineal insects *(coccidæ)*, so called from one of the species furnishing the well-known valuable dye-stuff. These little insects contrive to render their dead bodies useful to their future progeny, by protecting their eggs from the severity of the weather. They die in the act of incubation. Their eggs are deposited under their bodies, which become glued to the spot, and thus serve as a covering. In this state the dead insects appear on the bark of trees, like small warts, of various forms. The mother is seldom larger than a pepper-corn, yet the number of eggs which she lays amounts to several thousands. Some of them secrete a sort of white silky gum, very like gossamer, as the first bed of their eggs. Some naturalists have supposed this substance to be of the nature of the spider's web; but the author of "Insect Transformations" says he has ascertained it to be "precisely similar to the gluten which envelopes the eggs of most insects."

SEVENTH WEEK—WEDNESDAY.

HYBERNATION OF INSECTS.—VARIOUS STATES.

Turning from the consideration of insect eggs, let us look to some of the other means which the Creator has employed for preserving these minute animals during the

rigorous season of the year. Some assume the chrysalis form, in which state they require no food, and can endure a greater degree of cold than in their more perfect condition, though they are much inferior, in this respect, to the eggs already mentioned. We shall take an example of this method of hybernation from the butterfly family, which is remarkable for the variety of modes by which the Author of Nature has provided for the safety of the different species. The history of the large white butterfly, which we select, is not perhaps so peculiar, among the insect tribes, as it is remarkable. It undergoes a double round of transformations in the course of the year, and its instincts are wonderfully adapted to the state of the season in each. From the chrysalis state, these insects assume that of caterpillars, about the last days of April, or the beginning of the following month. They first appear on wing in the middle of May, and, about the end of the same month, lay their eggs in clusters on the under side of cabbage-leaves. In a few days after, the caterpillars come forth, and continue to feed together till the end of June, when they are at their full growth. They then wander about in search of convenient places to fix themselves, where, after their change, the chrysalis may be sheltered. When such are found, they each fasten their tail by a web, and carry a strong thread of the same round their body, near the head; and, thus firmly secured, hang a few hours, when the chrysalis becomes perfectly formed, and divested of the caterpillar's skin. In fourteen days after this, the fly is on the wing.* Such is the history of their first series of transformations. But a long period of genial weather still remains, and a new succession of changes takes place. The butterfly lays its eggs, which are again converted into caterpillars, and about the end of September, these caterpillars become chrysalides, in which state they are prepared to pass the winter. Now, however, as if acquainted with the change which nature is about to undergo, they do not seek for

* Goldsmith's Animated Nature, Note by Captain Brown, vol. iv. p. 297

protection beneath the fading vegetation which formed their previous retreat, but may be found hanging under the copings of garden walls, under pales, and in other places, where they can have a tolerable shelter from the inclemency of the weather, and yet be in the neighbourhood of their food, when they throw off this state of inactivity on the revival of nature in spring.

An instance of the hybernation of insects, in the *caterpillar* state, may be found in another branch of this family, that of the Marsh Fritillary. These small butterflies, the colour of which is a brownish orange, variegated with orange and black, are found in the caterpillar state, in the month of September. As the season advances, they spin for themselves a fine web, in which they congregate, and under covert of which they pass the winter. During this time, they are so nearly reduced to a torpid state, as to require no food; nor do they venture out of their covering, till invited by the warmth of spring. They have not yet come to their full size, and their growth is suspended during winter. If we pursue their history a little farther, we find that, about the end of April, they are in full maturity, and, suspending themselves by the tail, change into chrysalides. "Their mode of suspension," says Captain Brown, "is a singular instance of the extraordinary power of instinct. They first draw two or three small blades of grass across toward the top, and fasten them together by means of their silk, then hang themselves beneath the centre of these, each having his own little canopy. By this means, they are not only hidden from the sight of birds, but defended, in a great measure, from the damage they might otherwise sustain from windy and boisterous weather."*

In speaking of the hybernation of caterpillars, we must not forget to mention a beneficent provision by which many species are defended from the cold; we allude to the hair which at that season covers their bodies. The younger Huber found some larvæ of the smaller species

* Goldsmith's Animated Nature, Note, p. 298.

of ants, which spend the winter heaped up in the lowermost floor of their dwelling; and he remarks, that "those which are to pass the winter in this state, are covered with hair, which is not the case in summer, affording another proof of that Providence with which naturalists are struck at every step." Now, the very same thing occurs among various tribes of caterpillars, though it is by no means the case with all insects that pass the winter in this form. Even those which envelope themselves in silken shrouds, have generally this additional protection, of which the caterpillars of the brown-tail moth and mallow butterfly are instances. Some are thickly clothed with hair, a remarkable example of which occurs in the caterpillar of the drinker moth, whose very feet are covered with fine shaggy down. This insect does not become torpid in winter; and, as it feeds on grass, it can always find plenty of food. "When a fine sunny day chances to break in upon the gloom of winter, this pretty insect may be often seen stretched at its full length on a low twig, or the withered stem of a nettle, basking in the sunshine with apparent delight."*

Some insects survive the winter in their perfect state, but these are comparatively few. Several species of the genus *Vanessa* are of this number; but it is observed by Mr Rennie, that this can only be positively affirmed of the female. It is certain, however, that, even in this state, insects will bear an almost incredible degree of cold with impunity. We extract two instances recorded in the publication of Mr Rennie, on Insect Transformations, already alluded to.† "In Newfoundland, Captain Buchan saw a lake, which, in the evening, was entirely still and frozen over; but, as soon as the sun had dissolved the ice in the morning, it was all in a bustle of animation, in consequence, as was discovered, of myriads of flies let loose, while many still remained infixed and frozen round." A still stronger instance is mentioned by Ellis, in which "a large black mass, like coal or peat

* Insect Transformations, p. 193. † Ib. p. 406.

upon the hearth, dissolved, when thrown upon the fire, into a cloud of mosquitoes (*Culicidæ*)."

One other remarkable instance I shall mention, not only because it relates to another form of the hybernating principle, but also because it throws light upon a passage of Scripture, which naturalists were inclined to consider as founded on mistake. The passage to which I allude, is from the Proverbs of Solomon, whose wisdom and intelligence the infidel would be glad to impugn if he could. The words are,—"Go to the ant, thou sluggard; consider her ways, and be wise; which having no guide, overseer, nor ruler, provideth her meat in the summer, and gathereth her food in the harvest."* It has been alleged, that the ant has no such instinct; that indeed if she had, it would be altogether useless to her, as, in winter, she falls into a state of torpidity; and that Solomon must, therefore, have mistaken for her winter store, the larvæ of this insect, which she tends with much assiduity, and which are found carefully deposited in her nest. But it is gratifying to the pious mind to observe in how many instances the discoveries of science throw light on the difficult passages of Scripture; and prove the accuracy of its statements, even in matters of natural history, which it incidentally notices. Of these instances this is one. It is true that, in climates such as that of Europe, where the cold of winter is intense, the ant does fall into a state of torpidity; and, as if she anticipated this state, she makes no provision for the severity of winter. But it is different, at least with one species of ant, in India, named by Mr Hope the *Provision* Ant, as is stated by Mr Kirby, on the authority of Colonel Sykes. "These ants," says Mr Kirby, "after long-continued rains, during the monsoon, were found to bring up, and lay on the surface of the earth, on a fine day, their stores of grass-seeds, and grains of Guinea-corn, for the purpose of drying them. Many scores of these hoards were frequently observable on the exten-

* Proverbs vi. 6.

sive parade at Poona. This account," he adds, "clearly proves that, where the climate, and their circumstances, require it, these industrious creatures do store up provisions." The storing propensity of the ant, thus attested, serves to indicate the accuracy of Solomon's information; and, after this discovery, there can be little doubt, that, though the naturalist, who is too little acquainted with the animals of the Holy Land, has not yet ascertained the fact by actual observation, these insects do, in that country, follow a similar instinct, during its mild winter.

The immense variety of the insect tribes, and the inexhaustible resources of the Author of Nature in accommodating their instincts and functions to their peculiar circumstances and condition, precludes the possibility of comprising any thing like a particular detail of the manner in which the various tribes are enabled to pass the winter months, within the bounds we have prescribed to ourselves. The above sketch will suffice to afford some insight into these wonderful and diversified provisions, and to direct the reader to inquiries which will amply repay his industry, and which he will find growing upon him at every step. Some observations on the hybernation of the honey-bee, the snail, and the beetle, which will be found in subsequent papers, must close my observations on this part of the history of insects. Their still more astonishing faculties and modes of existence, in the other seasons of the year, will be considered afterward.

SEVENTH WEEK—THURSDAY.

HYBERNATION OF BEES.

Among insects, there is none more commonly known, or more universally admired for its extraordinary in-

stincts, than the honey-bee. Of these instincts, such as are intended for its preservation during winter, come particularly under our present notice; but it may be proper to premise a few words as to the general state and economy of this wonderful insect. The inhabitants of a hive have been usually divided into three distinct classes, viz. the queen, the drones, and the workers; but it has been recently discovered that there is yet another distinct class, or at least that the working-bees may be divided into two separate tribes or castes, called *Nurse-bees* and *Wax-workers*. This last distinction, which is not generally known, was ascertained by M. Huber, and is too curious to be passed over, especially as it is on the wax-workers that the winter provision of food entirely devolves. The business of the nurse-bees, which are somewhat smaller than the wax-workers, is to collect honey for the immediate subsistence of those which do not leave the hive, as well as of the young grubs, of which latter they seem to have the special charge, and also to give the finishing touches, as it were, to the cells and combs left imperfect by the others. The duty of the wax-workers, on the other hand, is to provide cells, in which the queen may deposit her eggs, and reservoirs, in which they may store the honey for future use; and it has been found, by accurate observation, that the one caste does not interfere with the functions of the other. The offices of the queen and of the drones are well known, the former being the absolute monarch of the hive, and the mother of its progeny; the latter being all males, and intended by nature for the fecundation of the queen. Of the drones, it is said that there are not more than the proportion of 100 to a hive consisting of 5000 or 6000. Of the latter, though several are produced, only one is permitted to live, this autocrat bearing no rival near her throne.

Such being the remarkable constitution of this industrious community, let us now see in what manner they are directed by the Author of their instincts to secure

themselves against the sterility of the winter months. First of all, it seems to be a law of this little commonwealth, that no idlers shall be permitted to exist. The drones contribute nothing to the wealth of the hive. They have fulfilled their part as soon as the queen is rendered fruitful; and, when this important point has been gained, and the hive has been secured in the means of future increase, or, at least, before any serious and united effort is made to complete the winter's provision, the unfortunate drones are condemned to utter extermination. In July or August, the whole working-classes seem to be suddenly seized with a deadly fury toward the unproductive part of the great family. They chase their unhappy victims from every place of refuge, till at last they are brought to the bottom of the hive, where they are indiscriminately massacred, their bodies being transfixed with many wounds, and then thrown lifeless out of the hive. So great is their antipathy, at this time, to the whole race of drones, that they simultaneously destroy the male eggs and larvæ, and tear open the cocoons of their pupæ, in order to devote them to one common destruction. "This destruction of the males, however," says the Supplement to the Encyclopedia Britannica, "is not the effect of a blind and indiscriminating instinct; for, if a hive be deprived of its queen, the massacre does not take place, while the hottest persecution rages in all the surrounding hives. In this case, the males are allowed to survive one winter." The providential design of this doubtless is, that, should a young queen be reared, she may find a husband.

No sooner has the hive got rid of the incumbrance of the drones, than they commence, with the greatest assiduity, to lay up their winter stores. During the preceding months of summer, honey was to be found in great abundance, being yielded by almost every flower; and they had partly availed themselves of that season of exuberance, to replenish their cells. But they had not set about the matter in good earnest;—they had consi-

dered it as a pastime, rather than as a task :—when they poured the delicious food into their cells, it would seem to have been rather with the view of disgorging a too plentiful meal, and of relieving themselves from the effects of gluttony, than from any care about the future. They had been luxuriating in overflowing sweets, and were little careful of a coming season of scarcity.

Now, however, the state of things is altered. Though the season is still fine, the honey-bearing flowers have begun to appear in less plenty, and much remains to be done, with diminished means. The young brood are fast vacating the cells, where they were hatched, and these cradles must now be converted into storehouses. All is bustle and animation. Not an idler is to be seen. The queen, like a presiding genius, hurries from place to place, to see that all are at their proper tasks. Some clean out the emptied cells, or rather smooth and prepare them, for the cocoons of the maggots are never removed; others repair the wax, where injured, or, if necessary, construct new depositories; while others, again, fly far and wide in search of the honey and pollen, which are to form the treasure of the hive, and to preserve them from want in the winter, and early days of the future spring. The eagerness and industry of these tiny foragers, is quite delightful. Not only do they rifle the nectaries of flowers, especially those of the clover and heath; but put in requisition the ripening fruits, when pierced by birds, and the leaves of some trees, from which a saccharine fluid, at this season, exudes, and even the honey-dew, as it is called,—an excrement emitted by the aphides.

It sometimes happens, however, that an unfavourable harvest causes all these resources to fail, and a coming famine is anticipated. The bees are then thrown upon their shifts, and the law of self-preservation overcomes the respect which they seem otherwise inclined to show to the property of their neighbours. "On these occasions," says the author of the article in the Supplement

to the Encyclopedia, already alluded to, "the distressed bees often betake themselves to plunder. Spies are sent out to examine the neighbouring hives. Allured by the smell of honey, they examine the appearance and strength of its possessors; and, selecting the weakest hive as the object of attack, they begin a furious onset, which costs great numbers their lives. If the invaders should fail in their attempt to force the entrance, they retreat, and are not pursued by those they have assailed; but if they succeed in making good the assault, the war continues to rage in the interior of the hive, till one party is utterly exterminated;—reinforcements are sent for by the invading army;—and the bees from the neighbouring hives often join the assailants, and partake of the plunder. In a short time, the whole of the enemies' magazines are completely emptied. If, on the other hand, the invaders should be defeated, the successful party is by no means safe from the attacks of the bees from other hives, if any of them should chance to have mingled in the fray, and especially if they have once penetrated as far as the magazines; for, in that case, they are sure to return, accompanied with a large reinforcement; and the unfortunate hive that has been once attacked, ultimately falls a sacrifice to those repeated invasions."

Meanwhile, the year advances, and the increasing cold warns the little commonwealth, that it is dangerous to go abroad; and, indeed, the growing deficiency of their natural food, convinces them, before the end of autumn, that the period of cessation from labour out of doors has arrived. They now live on their collected provisions, till the reduced temperature of the atmosphere causes them to lose their appetite, and to become torpid. The sleep of this little insect is by no means so deep, or so continuous, as that of many other species of animals; and, had not the Creator endowed them with the wonderful industry and forethought we have described, the whole species would soon become extinct in this northern climate, and indeed in almost any climate of the temperate

zone. Some naturalists have even disputed the fact of the torpidity of the bee, under any ordinary circumstances; while others have gone to an opposite extreme. We believe there is no doubt, that, in an equable temperature approaching to frost, bees do become torpid,—a proof of which is to be found in the fact, that a hive, buried, in the beginning of winter, under ground, will survive till spring, when it maybe disinterred in a healthy state, without much exhaustion of its winter stock. Now, it has been proved by various experiments, that a current of air through a hive is absolutely necessary to the existence of bees in their active state, and that this ventilation is kept up by means of the bees themselves, who use their wings for that purpose, which produces the humming noise to be observed in hives. Were the bees, therefore, when buried, awake and active, they would assuredly be suffocated. Several of our most celebrated naturalists, however (and, among the rest, the elder Huber), affirm positively, that bees do not become torpid in winter. He says, that the heat of a well-peopled hive is as high as 86° of Fahrenheit, even in the depth of winter, when the thermometer, in the open air, is several degrees below zero, this heat being generated by the bees clustering together, and keeping themselves in motion; and that, even in this degree of external cold, they may be heard buzzing, as they always do when ventilating the hive. Reaumer, as well as other distinguished observers, as positively maintains the opposite, and more popular, opinion. Our own belief is, that the truth lies between;—that the ordinary state of a hive, in cold weather, is, as we have already observed, a state of torpidity, but that bees are easily excited, and that, when roused, the temperature of the hive quickly rises, in proportion to their alarm or irritation. While we think, therefore, that Huber's experience may thus be accounted for, we heartily acquiesce in the following observations of Reaumer, taken as expressing the general state of a hive in winter. "It has been established," says he, "with a

wisdom which we cannot but admire—with which every thing in nature has been made and ordained—that, during the greater part of the time in which the country furnishes nothing to bees, they have no longer need to eat. The cold, which arrests the vegetation of plants,—which deprives our fields and meadows of their flowers, throws the bees into a state in which nourishment ceases to be necessary to them: it keeps them in a sort of torpidity, in which no transpiration from them takes place, or at least during which the quantity of what transpires is so inconsiderable, that it cannot be restored by aliment, without their lives being endangered."

The following humane observations, in a recent publication, are well worthy of attention, and we strongly recommend to bee-breeders the practice of Mr Nutt, as detailed by this author, by which the cruelty he deprecates may be avoided, even with profit.

"The usual practice of obtaining honey from domestic bees, was one of great, and, as it should seem, wanton and unnecessary cruelty. The little creatures, after they had toiled throughout the whole season, were not only deprived of all the winter store which they had accumulated, but they were smoked with sulphur in the hive, by means of which both old and young were entirely cut off. There is a degree of unfeeling cruelty in this, at which the mind revolts; because, though all creatures are, in *some way* or other, adapted for the use of man, the destruction of the creatures is no part of man's legitimate occupation. He has, undoubtedly, a right to his share of every production of the earth, which can in any way contribute to his comfort; but it is his duty and his interest to take that share, in wisdom, not in wantonness; and he could, upon every occasion, so manage matters, as that the quantity which he takes, might benefit that which is left; and thus, while he uses, he might ameliorate and improve all that grows and lives around him; and so be the adorner of creation, and not the destroyer.

"Many plans have been resorted to, for the preservation of bees, and the leaving of as much honey as shall support them during winter. One of the most recent, and, perhaps, the best of these, is that introduced by Mr Nutt, a cultivator of bees in Lincolnshire. In this method, three boxes are placed together, with a door for entrance in the central box only, but with a communication between it and each of the lateral ones. By means of ventilation, the two side boxes are kept at a heat which is well adapted for labouring bees, but below that at which the young are hatched. The bees are placed, at first, in the central box only; and when the first swarm of the season is produced, and would depart, admission is given to one of the side boxes; and, when that is filled, similar admission is given into the other. The temperature of these is regulated by means of ventilators; and, when it is ascertained that one of them is full, as much ventilation is given to it, as drives all the bees into the central box; the communication between them is closed, and the box is removed, without the destruction of a single bee.

"This is not the only advantage gained, for the honey is purer, and altogether of superior quality. The low temperature of the side boxes, not only prevents a queen bee from taking up her abode in them; but none of the eggs, the young, or the substances required for their nourishment in the larva state, are ever deposited in those boxes. Thus they contain only honey-cells and honey; and as those cells are constructed only as they are required, the combs are always full.

"By this means, from one swarm of bees, cultivated for five years, Mr Nutt obtained 737 lbs. of honey, and left 712 lbs., during the currency of the time for the maintenance of the bees, the increase of which was regularly progressive during the whole time, which, from its superior quality, would be worth fourteen guineas, on the average of every year, besides the expense of bringing it to market. There are very many situations in

this country, where every cottager might cultivate one such establishment of bees, the profits of which would suffice to furnish himself and his family with comfortable clothing, and also to replace their household furniture."*

SEVENTH WEEK—FRIDAY.

HYBERNATION OF THE SNAIL.

The garden-snail has its congeners in the waters, which, in outward appearance, bear a striking resemblance to it; but its habits and instincts are quite different from those of the same genus in another element. It is admirably adapted to its mode of life, and is furnished with organs almost as complete as the largest animal; with a tongue, brain, salival ducts, glands, nerves, stomach, and intestines; with liver, heart, and blood-vessels. These it possesses in common with other animals; but it has some striking peculiarities,—one of which is, that, of four flexible horns with which it is furnished, the two uppermost are gifted with eyes, which appear like black spots on their extreme ends, and which it can hide, by a very swift contraction, in the interior of its body. Every one knows, that another peculiarity which distinguishes it from other land animals, is its shell, which it carries on its back wherever it goes, and which serves at once as its house for lodging, and as its armour for defence.

The history of this animal, so far as it suits our present purpose to advert to it, is as follows:—Each individual snail is both a father and a mother; and it lays its eggs in shady and moist hollows, which it excavates with a member which is called its foot, as by this it has the power of locomotion. These eggs are hatched, sooner or later according to the temperature, producing little

* Mudie's edition of Wesley's Natural Philosophy, vol. ii. pp. 264-266

snails, exactly resembling their parent, but so delicate, that a sun-stroke destroys them, so that few, comparatively speaking, reach the end of the first year, when they are sufficiently defended by the hardness of their shell. The animal, at its first exclusion, lives solely on the pellicle of the egg from which it was produced. "Providence," as Kirby justly observes, "which, in oviparous and other animals, has provided for the first nutriment of the young in different ways, appropriating the milk of the mother to the young of quadrupeds, the yolk of the egg to those of birds, tortoises, and lizards, and the white of the egg to frogs and toads, has made this pellicle, or coat, the best nutriment of the young snail. In fact, this pellicle, consisting of carbonate of lime, united to animal substance, is necessary to produce the calcareous secretion of the mantle, and to consolidate the shell, as yet too soft for exposure." When this natural envelope is eaten, the young snail finds its nourishment in the vegetable soil around it. After the concealment of a month, it appears on the vegetable productions of the garden or meadow, which it seems indiscriminately to devour,—its house still growing with its growth, till it has completed five convolutions, by which time the animal has attained its full size.

These snails cease feeding when the first chills of autumn are felt; and, generally associating in considerable numbers, on hillocks, in the banks of ditches, or in thickets and hedges, set about their preparations for their winter retreat. They first expel the contents of their intestines, and then, concealing themselves under moss, grass, or dead leaves, each forms, by means of its foot, and the viscid mucus which it secretes, a cavity large enough to contain its shell. The mode in which it effects this is remarkable; collecting a considerable quantity of the mucus on the sole of its foot, a portion of earth and dead leaves adheres to it, which it shakes off on one side; a second portion is again collected and deposited, and so on, till it has reared around itself a kind

of wall, of sufficient height to form a cavity that will contain its shell; and then, by turning itself round, it presses against the sides, which renders them smooth and firm. The dome, or covering, is formed in the same way; earth is collected on the foot, which it then turns upward, and throws off by exuding fresh mucus; and this is repeated, till a perfect roof is formed. Having now completed its winter house, it draws in its foot, covering it with the mantle, and opens its spiracle to draw in the air. On closing this, it forms, with its slime, a fine membrane, interposed between the mantle and extraneous substances. Soon afterward, the mantle secretes a large portion of very white fluid over its whole surface, which instantly sets uniformly, and forms a kind of solid operculum, like plaster of Paris, about half a line in thickness, which accurately closes the mouth. When this is become hard, the animal separates the mantle from it. After a time, expelling a portion of the air it had inspired, and thus being reduced in bulk, it retreats a little further into the shell, when it forms another leaf of mucus; and it continues repeating this operation, till there are sometimes five or six of these leaves, forming cells filled with air between it and the operculum. Respiration ceases during the period of hybernation.*

The mode in which these animals escape from their winter confinement, is singular:—The air which they had expired, on retiring into their shell farther and farther, remains between the different partitions of the mucous membrane above mentioned, which forms so many shells hermetically sealed;—this they again inspire, and thus acquiring fresh vigour, each separate partition, as they proceed, is broken by the pressure of the foot, projected in part through the mantle;—when arrived at the operculum, they burst it by a strong effort, and finally detaching it, then emerge, begin to walk, and to break their long fast!

* Goldsmith is mistaken when he says, that the snail opens an air-hole into its shell.—*Gaspard and Bell; Zoological Journal*, i. 93; ii. 174.

"In all these proceedings," observes Mr Kirby, after recording the above details, "the superintending care and wise provisions of a Father-Being are evident. This creature can neither foresee the degree of cold to which it may be exposed in its state of hybernation, nor know by what means it may secure itself from the fatal effects it would produce upon it, if not provided against.

"But, at a destined period, often when the range of the thermometer is high, not stimulated by a cold atmosphere,—except perhaps by the increasing length of the night,—at the bidding of some secret power, it sets about erecting its winter dwelling; and, employing its foot, both as a shovel to make its mortar, as a hod to transport it, and a trowel to spread it duly and evenly, at length finishes and covers in its snug and warm retreat; and then, still farther to secure itself from the action of the atmosphere, with the slimy secretion with which its Maker has gifted it, fixes partition after partition, and fills each cell, formed by it, with air, till it has retreated as far as it can from every closed orifice of its shell, and thus barricades itself against a frozen death. Again, in the spring, when the word is spoken,—*Awake, thou that sleepest*, it begins immediately to act with energy; it reinspires, as above related, the air stored in its cells; bursts all its cerements; returns to its summer haunts, and again lays waste our gardens."*

SEVENTH WEEK—SATURDAY.

HYBERNATION OF THE BEETLE.—ANIMALCULES IN PASTE.

Among insects, the beetle has some peculiar instincts, which will come more properly under our observation at another season. At present, I shall only mention

* Kirby's Bridgewater Treatise, pp. 285-289.

three instances of remarkable habits relating to the state of particular species of this insect in winter. This tribe, it may be premised, are distinguished from others of the same order, by being furnished with cases to cover two transparent wings. Like other insects, they are bred from eggs, which first become grubs; then chrysalides, in which parts of the future fly are distinctly seen; and, lastly, assuming their perfect or *imago* state, they acquire wings, and mount into the air.

The first species of this little animal which I shall introduce to the notice of my readers, is the May-bug, or Dorr-beetle, well known to children by its evening buzz during the months of summer. In its maggot state, in which it remains, without other change than increase of size and the annual renewal of its skin, for no less a period than three years, it burrows under ground, so near the surface, as to devour the roots of plants, on which it feeds voraciously, and without discrimination. When largest, it is found an inch and a half long, of a whitish-yellow colour, with a body consisting of twelve segments or joints, on each side of which there are nine breathing holes, and three red feet; but it is destitute of eyes, having no occasion for them in its natural habitation, where light does not penetrate,—here exhibiting a new and remarkable instance of the attention of the Creator, in adapting the faculties of creatures to the situation for which they are destined, as well in what he withholds, as in what he grants.

At the end of the fourth year of its existence, it begins to provide itself a secure winter habitation, with a view to its future change. About the latter end of August, it seems first to come under the influence of that extraordinary instinct, which leads it to prepare for its important change. It then buries itself deeper and deeper in the earth, sometimes, in favourable situations, to the depth of six feet, and there forms for itself a capacious apartment, the walls of which it renders very smooth and shining, by the exertions of its body. Its abode

being thus formed, it begins soon after to shorten itself, to swell, and to burst its last skin, in order to assume the form of a chrysalis. This, in the beginning, appears of a yellowish colour, which heightens by degrees, till at last it appears nearly red. Its exterior form plainly discovers all the vestiges of the future winged insect, the entire fore-parts being distinctly seen; while, behind, the animal seems as if wrapped in swaddling-clothes.

The young May-bug continues in this state for nearly three months, and then divests itself of all its impediments, and becomes a winged insect, completely formed. This happens about the beginning of the year; but it is not yet time for it to emerge into open day, the season of the year being unpropitious to its new habits. Unlike most other insects, therefore, which, immediately after their change, enter at once into all the enjoyments of their new being, it remains in a state of infant imbecility for four months longer, during which time, though without food, it gradually acquires firmness and vigour; and, about the end of May, when the genial season has returned, it works its way to the light and warmth of the summer's atmosphere, where, from living for four years under ground, and feeding only on roots, it buzzes joyfully through the mild air, having the sweetest vegetables for its banquet, and the dew of evening for its drink.

Another insect, allied to the beetle kind, which I select, is still more remarkable in its instincts, if any thing in this world of wonders can be said to have the pre-eminence: I allude to the nut-weavil (*Curculio bucum*). Dr Good has chosen this little creature as an illustration of the absurdity of the hypothesis, which makes instinct to depend on imitation, education, or reasoning; and, assuredly, even though the supposition were not contradicted by almost every habit and pursuit of the inferior creation, this instance might of itself be sufficient to show the untenable nature of the theory. The nut-weavil, "with a finished knowledge of her art," as Dr Good ex-

presses it, singles out a nut in the month of August, while its shell is yet soft and penetrable; and, having prepared to deposit her eggs, pierces it with her proboscis, and then, turning round accurately, drops an egg into the minute perforation. Having accomplished this, she passes on, pierces another nut, drops another egg, and so continues, till she has exhausted her whole stock. The nut continues to grow; the egg is soon hatched; the young maggot finds its food already ripened, and in waiting for it; and, about the time of its full growth, falls with the mature nut to the ground, and at length, when its provision here is exhausted, creeps out, by gnawing a circular hole in its side. It then burrows under the surface of the ground, where it continues dormant for eight months, at the termination of which it casts its skin, becomes a chrysalis of the general shape and appearance of the beetle kind, and, in the beginning of August, throws off the chrysalid investment, creeps to the surface of the ground, finds itself accommodated with wings, becomes an inhabitant of the air, and instantly pursues the very same train of actions, to provide for a new progeny, which had been pursued by the parent insect of the year before.

One more example which I shall notice, of the habits of particular species of the remarkably varied class of beetles, is of a very different kind; and my object, in adverting to it, is to show another principle, by which the sterility of winter is rendered innoxious to certain animals. We have seen instances in which, among vertebrated as well as invertebrated beings, the expedient of torpidity is resorted to by the Author of Nature, to sustain life, and perhaps enjoyment also, during this rigorous season. But, in the example I am going to produce, there appears to be no need of this suspension of motion and external sensation, as the little creature is able to survive a whole winter, and even much longer, without any food whatever, except what is derived from the atmosphere; and this, indeed, is a property which

belongs to various classes of the invertebrated genus. The account is taken from the communication of a writer in the Philosophical Transactions:—"On the removal of a large leaden cistern, I observed, at the bottom of it, black beetles. One of the largest I threw into a cup of spirits,—it being the way of killing and preparing insects for my purpose. In a few minutes, it appeared to be quite dead. I then shut it up in a box, about an inch and a half in diameter, and, throwing it into a drawer, thought no more of it for two months; when, opening the box, I found it alive and vigorous, though it had no food all the time, nor any more air than it could find in so small a box, whose cover shut very close. A few days before, a friend had sent me three or four cockroaches. These I had put under a large glass; I put my beetle among them, and fed them with green ginger, which they ate greedily; but he would never taste it, for the five weeks they lived there. The cockroaches would avoid the beetle, and seemed frightened at his approach; but he usually stalked along, not at all regarding whether they came in his way or not. During the two years and a half that I have kept him, he has neither ate nor drank.

"How, then, has he been kept alive? Is it by the air? There are particles in this, which supply a growth to some species of plants, as sempervivum, orpine, and house-leek. May not the same or like particles supply nourishment to some species of animals? In the amazing plan of Nature, the animal, vegetable, and mineral kingdoms, are not separated from each other by wide distances; indeed, their boundaries differ from each other by such minute and insensible degrees, that we cannot find out certainly where the one begins, or the other ends. As the air, therefore, nourishes some plants, so it may nourish some animals; otherwise, a link would seem to be wanting in the mighty chain of beings. It is certain, camelions and snakes can live many months without any visible sustenance, and probably not merely by their

slow digestion, but rather by means of particles contained in the air, as this beetle did; yet, doubtless, in its natural state, it used more substantial food. So the plants above mentioned thrive best with a little earth, although they flourish a long time, and send forth branches and flowers, when they are suspended in the air. Even in the exhausted receiver, after it had been there half an hour, it seemed perfectly unconcerned, walking about as briskly as ever; but, on the admission of the air, it seemed to be in a surprise for a minute."

It is impossible not to view with wonder and admiration, the various ways in which animal life is sustained, sometimes even under circumstances which, arguing from ordinary analogies, would seem to insure its destruction. I have already alluded to the power possessed by some insects' eggs, to resist extreme cold; and, before passing to the hybernation of higher species, I shall conclude this paper by remarking, that there are some very minute kinds of animalcules, the germs of which seem capable of resisting the extremes both of heat and cold. If the paste of flour, which has been boiled ever so long in the making, be allowed to become sour, and then be mixed with water, the mixture, when a microscope of sufficient magnifying power is applied to it, will appear to be composed, almost entirely, of little eels, very handsomely formed, and moving about with great activity. Allow the same mixture of paste and water to become solid by drought, or by freezing, and let it be again moistened or thawed, and it will be as completely peopled as ever, with its microscopic inhabitants. Now, as it would be quite unphilosophical to admit the principle of equivocal generation, we are bound to conclude, that the germs of these living creatures were lodged in the mixture, before it was subjected to the process of boiling, and were only developed by the subsequent fermentation; so that it would appear, in this case, that the principle of life, in whatever form it may exist, is inde-

structible by very great alternations of heat and cold; and, indeed, we are not warranted to affix boundaries to this power, or to conclude, from the experiments which have yet been made, that any length of time, however extended, or any degree of heat or cold, however great, would be sufficient to destroy the vitality of these germs.

The wonders, indeed, which an examination of the incalculably numerous and amazingly diversified classes of invertebrated animals discloses, grow upon us in every direction as we proceed; and the pious exclamation of the psalmist recurs to us perpetually,—"O Lord, how manifold are Thy works! In wisdom hast Thou made them all."

EIGHTH WEEK—SUNDAY.

GREATNESS OF GOD EVEN IN THE SMALLEST THINGS.

The following reflections of Mr Sturm, the well known popular German writer, are so appropriate, as a sequel to our observations in the course of the preceding week, as well as to the previous notices respecting the wonders of the microscope, that I think it would not be easy to direct my readers to a more proper subject of consideration on this sacred day.

He who delights to contemplate the works of God, will not only discover his hand in those immense globes which compose the system of the universe, but also in the little worlds of insects, plants, and metals. He will search for, and adore the wisdom of God, as well in the spider's web, as in the power of gravitation, which attracts the earth toward the sun. These researches are at present the easier, as microscopes have discovered to us new scenes and new worlds, in which we behold, in miniature, whatever may excite our admiration. They who have not the opportunity of using such instruments will read at least with pleasure, the following remarks on microscopic objects.

Let us, in the first place, observe the inanimate world. Behold those mosses and little plants which God has produced in such abundance. Of what extremely small particles and fine threads are these plants composed! What a variety in their forms and shapes! Who can enumerate all their genera and all their species? Think on the innumerable multitude of small particles of which every body is composed, and which may be detached from it! If a hexagon, of an inch square, contain 100,000,000 of visible parts, who can calculate all the particles which compose a mountain? If millions of globules of water may be suspended from the point of a needle, how many

must there be in a spring, in a well, in a river, in the sea? If, from a lighted candle, there issue in a second more particles of light than there are grains of sand in the whole earth, how many igneous particles must there issue from a large fire in an hour!* If one grain of sand contain more than 1,000,000,000 of particles of air, how many must there be in the human body! If men can divide one grain of copper into millions of parts, without arriving at the first elements of matter; if odoriferous bodies can exhale a sufficiency of odorous particles, so as to be perceived at a great distance, without any sensible diminution of weight in those bodies, it would require an eternity for the human mind to calculate the number of these particles

If we pass next to the animal kingdom, the scene will be infinitely extended. In summer, the air swarms with living creatures. Each drop of water is a little world full of inhabitants. Every leaf is a colony of insects; and every grain of sand is the habitation of a multitude of animated beings. Every species of plant, seed, and flower, nourishes millions of creatures.† Every person has seen those innumerable swarms of flies, gnats, and other insects, which gather together in a small space. What prodigious hosts must there be of them, that live, sport, and multiply their kind over the whole earth, and in the immense extent of the atmosphere! How many millions of still smaller insects and worms are there which crawl on the earth, or in the entrails of animals, the number of which are only known to God! With what splendour does the power of God manifest itself to the mind, when we reflect on the multitude of parts of which these creatures are composed, of whose very existence most men are ignorant! Were we not, at any time, able to prove it by experiment, could we

* This remark proceeds, of course, on the old theory of the emanation of light and heat. But, on the undulatory theory, the wonder is not lessened. —H. D.

† There seems to be somewhat of an overstatement here; but, with every abatement, the numbers of microscopic insects are incalculable.—H. D.

imagine there were animals a million of times less than a grain of sand, with organs of nutrition, motion, &c. There are shell-fish so small, that, even viewed through the microscope, they appear scarcely so large as a grain of barley; and yet they are real animals, with durable dwelling-places, the foldings and recesses of which, form so many different apartments. How exceedingly small is a mite: nevertheless, this almost imperceptible point, seen through a microscope, is a hairy animal, perfect in all its members, of a regular figure, full of life and sensibility, and provided with every necessary organ. Although this animal is scarcely visible to us, yet it has a multitude of still smaller parts; and, what is yet more admirable, the glasses which show us so many faults and imperfections in the most finished works of man, can observe nothing but regularity and perfection in these microscopic objects! How inconceivably thin and tender are the threads of a spider! It has been calculated, that it would take 36,000 of them to make the thickness of a thread of common sewing silk! Each of the six papillæ from which the spider draws that glutinous liquor of which it forms its web, is composed of a thousand insensible pores, which give passage to so many threads; so that, however fine the spider's thread may appear, it is composed of 6000 smaller ones!

You are struck with astonishment: but, suppose we had microscopes which could magnify some thousands of times more than those glasses do, through which a mite appears no larger than a grain of barley, what wonders should we then see! And, even then, should we reach the limits of creation in these inconceivably small productions? Certainly not: and it would be presumption and extravagance to believe it. Each creature has a kind of infinity; and the more we contemplate the works of God, the more the wonders of his power shall be multiplied in our sight.

Our imagination is confounded in the two extremes of nature, the great and the small; and we know not whether

we should admire the Divine power more in those enormous masses which roll over our heads, or in those microscopic objects which are invisible to the naked eyes. Should not the contemplation of the works of God be our most pleasing occupation? The trouble of study would be amply compensated by the pure and innocent pleasures which it would afford. It would, at least, awaken in us an ardent desire to arrive in those blessed regions where we should require neither microscopes nor telescopes to enable us to discover the wondrous works of God. There all his works shall be so unveiled to our eyes, that we shall be able to distinguish the destination, structure, and relations of each object. There immortal songs of praise shall resound to the honour of the Creator of the universe. There all distinction of great and small shall be entirely done away; for every thing shall appear great in our sight, and fill our souls with admiration and joy!

EIGHTH WEEK—MONDAY.

HYBERNATION.—MIGRATION OF BIRDS.

The migration of birds, before winter deprives them of their natural food, or diminishes the temperature of the atmosphere below what their constitution is able to bear, is not only one of the familiar, but one of the most remarkable operations of this interesting class of the animal creation. No person of observation can reside long in a rural district, without being struck with the change which takes place in its feathered inhabitants about the commencement of this less genial season. While hardier races of birds, unknown to us in spring and summer, begin to appear, we lose sight of many of those tenants of our hedges and groves, which cheered us with their music, or pleased our eye by the variety and brilliancy

of their plumage. They had long since almost ceased to afford us agreeable notice of their presence, by the distinctive variety of their music; but we had only a few days or weeks before seen them flitting gaily across our path, or perched quietly or peeringly on some neighbouring bough; yet now, neither to the eye or ear, do they any longer give indications of their existence. What has become of these interesting attendants on our summer walks? The solicitude to which reflections on their fate, during the vicissitudes of our rude winter climate, give rise, is beautifully and feeling expressed by the Scottish poet:—

> "Ilk happing bird, wee, helpless thing,
> Which, in the merry months of spring,
> Delighted me to hear thee sing,
> What comes o' thee?
> Where wilt thou cow'r thy chittering wing,
> And close thy e'e?"

Were we, indeed, for the first time, and without the correction of experience, to witness the arrival of winter, when the bountiful hand of nature seems suddenly to be withdrawn, it would appear to us impossible that the myriads, not only of the races of insects we have been considering, but of quadrupeds, birds, and reptiles, which swarm on the surface of the earth in the more genial months of summer and autumn, should be able, during the privations of this season, to preserve their comforts, or even their very existence. There is something appalling in the idea, that such multitudes of creatures should be called into being, only to fall victims to an inevitable and cruel fate; and it would seem to reflect on the wisdom or goodness of Providence, were such anticipations to be realized. But it is not so; and the beneficent contrivances by which such a calamity is averted, tend, in no slight degree, to intimate the presence and operation of an intelligent Creator.

With regard to those animals which are actually ex-

posed to the storms of winter, let it be observed, that this season of scarcity and privation, is immediately preceded by a period of peculiar plenty, when the edible seeds and plants are in greatest abundance; and that these, although they cease to vegetate, do not, in many instances, cease to exist as articles of food. The seeds and debris of plants lie scattered about the ground in great profusion; and, though unnoticed by us, are easily discovered by the microscopic eye of many of the inferior animals. The grass, too, which forms at once the soft carpet, and the favourite food, of so many living creatures, although faded, is still spread over our hills and valleys, and affords to the large classes of graminivorous animals, a more scanty indeed, but yet a considerable supply of succulent food. The roots of once luxuriant plants and flowers, the fruit of the bramble, the hawthorn, and the eglantine, the acorn, the beech-mast, and even the decaying leaves of the forest, all contribute their varied nourishment to different tribes of animated beings.

But to this subject we shall afterward have occasion more particularly to advert; and, with reference to the winged creation, we have at present to remark, that He, without whose permission "not even a sparrow falleth to the ground," and who "feedeth the ravens which have neither storehouse nor barn," deals in another manner with those tribes, to which subsistence could not now be afforded in the place of their summer residence; and, by means of a secret impulse, not less wonderful than it is beneficent, bears them beyond the reach of coming want, and the chilling breath of a wintry sky. The Creator is fertile in resources; and, as he has furnished this class of his living creatures with wings to travel through the air, where there are neither rivers nor seas to arrest their progress, and where they can readily overtop even the obtruding mountains, He has bestowed on them that mysterious instinct, which leads them to migrate to southern climes, where the food on

which they subsist is still abundant, and the arrival of winter has only mitigated the intensity of the heat, and rendered it to them little else than a continuance of the blessings of summer.

A continental writer has attempted to define the impulse which induces birds to migrate; but he has been forced to do so, after minute attention, more by negatives than by any positive and very intelligible assertion of a principle. "It is not want of nourishment," says M. Brehm, "for most of them commence their migration while there is still abundance in the country they are leaving. Atmospherical currents are not the cause, nor do the changes of season explain it, as the greatest number set off while the weather is yet fine; and others, as the larks and starlings, arrive while the season is bad. Atmospherical influences can only hasten the migration in autumn, but must rather retard or derange it in spring. It is the *presentiment* of what is to happen, which determines birds to begin their journey. It is an instinct which urges them, and which initiates them into the meteoric changes that are preparing. They have a particular faculty of foreseeing the rigours of the coming season; an exquisite sensibility to the perception of atmospherical changes which are not yet arrived, but are approaching."

The same intelligent and judicious writer states some facts relative to the manner of these migrations, which he conceives to be established; and, as they are curious in themselves, and condensed into few words, we shall make no apology for quoting them. "Every bird has its native country, where it freely reproduces, and remains part of the year, travelling in the remainder. Most birds spend half the year at their home, and pass the other half in travelling. Some, particularly birds of prey, travel by day, but by far the greater part travel by night; and some perform their migrations indifferently, either by day or night. They seem to pass the whole of their migration without sleep; for they employ the

day in seeking their food, stopping in the places where they are most likely to find it. They commonly keep very high in the air, and always at nearly the same distance from the earth, so that they rise very high over mountains, and fly lower along valleys. They require a wind that blows *against* them, as a contrary wind assists in raising them."*

In some subsequent papers, we shall follow out this interesting subject, by entering into a few details; but we cannot conclude this preliminary sketch, without a single remark respecting the astonishing faculty on which the migratory habits of birds is founded.

It would be vain to look for a solution of the phenomena of migration in the reasoning powers of the birds themselves. They have obviously neither a faculty of reflection, nor a geographical nor meteorological knowledge, which could enable them either to plan or to execute so astonishing an enterprise; and we are compelled to rank this means of self-preservation among the numerous habits and practices of the lower animals, which Brehm, already quoted, calls "a presentiment," "an instinct," "an exquisite sensibility," and which the immortal Newton justly and piously ascribes to "nothing else than the wisdom and skill of a powerful and ever-living agent."

* Quoted from Library of Entertaining Knowledge, on Faculties of Birds, p. 286. There appears in these remarks rather too much disposition to generalize. The author of the article from which the quotation is extracted, observes, that the last statement must be subject to some very large exceptions. The same may be probably said of some of the rest; and particularly of the first, which seems to aver that *every* bird travels during part of the year.

EIGHTH WEEK—TUESDAY.

HYBERNATION.—MIGRATION OF BIRDS CONTINUED.

Curiosity has long directed its inquiries to ascertain the countries, to which our various birds of passage migrate during the winter months; but it is mortifying to think how little definite information has been obtained on so interesting a question. That several of our native birds are capable of taking long and rapid flights, is generally known. The swallow and the hawk, for example, can continue on the wing, without rest, for many hours, and are believed to be capable of travelling at the amazing rate of 150 miles in the hour. Supposing, however, the average rate of the flight of birds to be only one-third of this velocity, it is obvious that they may, without difficulty, perform journeys to any extent necessary for carrying them to the warmest climates. From the British shore to the coast of France, the distance is comparatively so trifling, that, even taking the broadest part of the channel, it could, at the moderate average we have mentioned, be performed in little more than two hours; and thence again, stretching through the intervening countries of France and Spain, the journey to Africa might be accomplished in the short period of two or three days, making all reasonable allowance for needful rest. Supposing such data to be correct, this would obviously be no formidable labour; and, that we have not overstated the powers of the feathered race, may be gathered from various known facts. It is a matter of history, that a falcon belonging to Henry IV. of France, having escaped from Fountainbleau, was found, at the end of twenty-four hours, at Malta, a distance of about 1350 miles! It has been said, that birds generally begin their flight with an adverse wind; but, granting this to be the case, which we may be permitted to doubt,

the intention probably is, that they may thus be assisted to rise into a higher region of the atmosphere, where they may expect to meet with a counter current; for we can scarcely suppose that they purposely encounter the disadvantage of a permanent contrary breeze; and, should the gale be favourable, they would, without any effort, except what was just necessary to keep them afloat, be borne along, with the moving element, at the rate of thirty, forty, or even eighty miles an hour. As to the power of birds to keep, for a lengthened period, on wing, many remarkable facts have been mentioned. That of the blue bird of America seems to be beyond dispute, which, though one of the smaller species, passes and repasses annually, in great quantities, from the mainland to the Bermudas, a distance of not less than 600 miles, without any intervening land. "Nothing is more common in Pennsylvania," says Wilson, "than to see large flocks of these birds, in spring and fall, passing at considerable heights in the air, from the south in the former, and from the north in the latter season."

The distance to which some birds migrate from their native place, may be illustrated by the following anecdote, if it be worthy of credit, related in the article on the "Faculties of Birds," already alluded to, as found in several public journals. "Last year (1833), a Polish gentleman having caught a stork upon his estate, near Lemburg, put round its neck an iron collar, with this inscription, '*Hæc ciconia ex Polonia*,'—" (This stork comes from Poland),"—and set it at liberty. This year (1834), the bird returned to the same spot, and was again caught by the same person. It had acquired a new collar of gold, with the inscription, '*India cum donis, remittit ciconiam Polonis*' (India sends back the stork to the Poles with gifts). The gentleman having shown the inscription to his neighbours, again set the bird at liberty."

We shall not now be surprised to hear that the swallow, as well as several other British birds, such as the nightingale and the quail, should find its way to the

shores of Africa. Indeed, if it possess the strength and swiftness of the American blue-bird, and there is every reason to believe that it exceeds this point rather than falls short, it would require but a single resting-place in its passage, and arrive with ease on the second day.

As to the mode of migration, this differs in different species, some assembling in vast flocks, and taking their flight together, such as swallows, geese, &c. while others seem to prefer plying their solitary way. Of this latter kind is the cuckoo, which indeed is seldom at any time observed in company even with its mate. But what would scarcely be expected, and cannot easily be accounted for on the analogy of the other habits of the feathered family, there seem to be some kinds of birds, the males of which take their migratory flight unaccompanied by the females, who follow them at the interval of some days; and others, the females of which lead the way, and leave their mates behind. The nightingale and the wheat-ear are said to be of the ungallant habits of the first mentioned species.

While those birds, whose food fails, or becomes scanty in winter, take their flight, as we have seen, to more southern climates, their place is partly supplied by the immigration of winged strangers from the shores of the north, actuated obviously by a similar impulse, namely, that of escaping from a more rigorous region, and finding a supply of congenial food, when that of their summer haunts is about to be exhausted. These are chiefly sea-fowl, or the frequenters of lakes, or the inhabitants of fens and marshes; and it is doubtless, the approach, though not perhaps the actual arrival, of frost, about to bind their more northerly places of resort in icy fetters, and thus to render them unfit for their subsistence, which has made the instinct necessary that drives them southward.

It is worthy of notice, and what might confidently be expected from the nature of the case, that although our summer visitants are not confined to any particular order

or tribe, including, not only both land and water-fowl, but devourers of all different kinds of food, yet of those which reside among us, in winter, there are none insectivorous, and very few granivorous. It is also remarkable, that, while all our summer birds of passage hatch their young in this country, few, if any, of the winter kinds remain to execute this necessary duty. They leave our shores before the breeding-season commences, to give a birth-place to their progeny in their own native regions of Sweden, Norway, or Iceland, some of them, such as the snow-bunting, even approaching the Arctic Circle, and performing the office of incubation on the ice-bound coast of Greenland, or amidst the icebergs of Spitzbergen.

It is impossible not to admire the care which Providence has thus manifested, at once to preserve the winged tribes from the fatal effects of a change of climate, too severe for their nature, and to cheer the short summer of the northern regions with the presence of inhabitants, which only a few days of a stern polar winter would destroy. The spring, summer, and autumn of Spitzbergen, for example, are all comprised in the space of a few weeks. Even so late as the end of April, the whole island is a wild and dreary waste of ice and snow; not a sound of animated beings is to be heard; though the sun, after an absence of four dismal months, has appeared for some time, skirting, with his cold and languid lamp, the edge of the bleak horizon. Gradually, however, he rises higher in the southern heavens; and in May or June, his never-setting orb sheds a genial warmth through the placid air, and on the smiling earth. The change is like that of magic. The snows dissolve, and rush in torrents to the sea. The ground appears, first in spots, and then in one vast unbroken extent, along the valleys, and even on the less elevated hills. Instantly, the powers of vegetation burst forth with an energy of which we can scarcely form a conception. In a few days, a land, which seemed the region of perpetual snow, is clothed with the

loveliest verdure, and becomes instinct with life. The gaunt bear leaves his cave, where he had spent the winter in a happy torpidity, while numerous insects start from their winter tombs, and flutter gladly in the balmy atmosphere. It is at this auspicious period, that the snow-buntings, and perhaps some other winter birds, having lingered probably for a time in the intervening islands of Shetland, Faroe, and Iceland, arrive on this awakened coast, which they render vocal with their song; and, while they find a congenial climate, and food adapted to their nature, immediately begin the important offices required for the propagation of the species, obtaining, in this remote island, a retreat comparatively free from the molestation of the enemies of their species. In a few weeks, the sun begins again to lose its genial warmth, and symptoms of approaching winter warn these annual visitants to return to a more temperate climate; but this interval had sufficed, not only for the hatching of the brood, but for their being reared and cherished till they have acquired a strength of wing enabling them to accompany their adventurous parents, in shaping their pathless way for hundreds of miles across a stormy and apparently shoreless ocean, without a single land-mark in the distant horizon to direct their course.

The case of the little snow-bunting is only a particular instance, though a striking one, of that wonderful instinct which belongs to so many of the feathered family. It marks, in a very lively manner, the peculiar features, the extent, and the beneficent intentions of this impulse of a wonder-working power; and, while it fills the pious mind with an undefinable feeling of awe, under the sense of a present Deity, directs it to the cheering doctrines, and blessed promises, of Revealed Truth, and may well serve to increase its confidence in the never-failing protection of a reconciled Father, who bestows those secret and mysterious influences of Divine grace, through which the Christian is led "by a way which he knows not,"

from the wintry scenes of earth, to the glories of an eternal summer.

The snow-bird of America is another of the feathered tribe, which the hand of a beneficent Providence drives northward to fulfil some important end. When the weather begins to be warm, the snow-bird moves toward the colder regions, and arrives about the Hudson's Bay Factory in June, whence it continues its course still farther north, where it breeds. This kind is so numerous as to be found scattered over the greater part, probably the whole, of the northern regions of North America, in great profusion. Speaking of this remarkable species, Mr Wilson says, "In the circuitous route I travelled, of more than 1800 miles, I never passed a day, and scarcely a mile, without seeing numbers of these birds, and frequently large flocks of several thousands."

The impulse which urges these tenants of the air to seek the wilds of the north, is evidently connected with the instinct which leads them to propagate the species; and indeed some naturalists are of opinion, that, in all instances of migration, the same instinct operates. However this may be, it is certain that these little creatures find a more secure retreat in the countries near the Arctic Circle, for the important purpose of incubation, than could readily be chosen in the circle of their summer haunts. But, while they thus escape many formidable enemies, they are probably not altogether free from danger; for their appearance will be hailed as a seasonable boon of Providence, by the scattered inhabitants of these inhospitable regions, who must find, in this annual supply of dainty food, thus mysteriously sent them by an Unseen Hand, an agreeable and wholesome variety, after being confined, during the dismal winter months, to the unvarying sameness of that coarse, unsavoury, and oily nourishment, which their rude skill extracted from the surrounding seas.

EIGHTH WEEK—WEDNESDAY.

HYBERNATION.—OF BIRDS WHICH PARTIALLY MIGRATE.

There are some of the British feathered tribes, which, although they do not pass beyond the sea, are yet, to a certain extent, migratory within the bounds of the island. These are chiefly influenced in their change of residence, by the desire of finding a more remote retreat, for the purpose of incubation, or of acquiring a more plentiful supply of food, or, perhaps, in some instances, a more sheltered place of residence during the stormy months. "Of these," says Mr Rennie, "may be mentioned, in our country, the curlew and golden-plover, which in winter reside chiefly along the shores, while in summer they betake themselves to the inland lakes and moors; the lapwing, which seems to move northward in winter; the linnet, which in that season deserts the hilly regions, and approaches the habitations of man; and the dipper, which in summer ascends the streams, toward their sources."

But it is in continental countries, and especially in America, where interminable forests are mingled with districts and bounded by regions cultivated by the labour of man, and teeming with crops of grain, that the most remarkable instances of this kind of partial migration takes place. The countless multitudes of pigeons in that country, which, at particular seasons, shift their residence in continuous and almost interminable flocks, have long been the admiration of travellers. Audubon, in his usual graphic manner, describes a flight of this tribe to which he was an eye-witness. "In the autumn of 1813," says he, "I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. In passing over the Barrens, a few miles beyond Hardensburgh, I observed the pigeons flying from north-east to south-

west in greater numbers than I thought I had ever seen them before; and feeling an inclination to count the flocks that might pass within the reach of my eye in one hour, I dismounted, seated myself on an eminence, and began to mark with my pencil, making a dot for every flock that passed. In a short time, finding the task that I had undertaken impracticable, as the birds poured on in countless multitudes, I rose, and counting the dots then put down, found 163 had been made in twenty-one minutes. I travelled on, and still met more, the farther they proceeded. The air was literally filled with pigeons; the light of noon-day was obscured as by an eclipse; the dung fell in spots, not unlike melting flakes of snow; and the continued buzz of wings had a tendency to lull my senses to repose." "Before sunset," he adds afterward, "I reached Louisville, distant from Hardensburgh fifty-five miles. The pigeons were still passing in undiminished numbers, and continued to do so for three days in succession."—* * * "The atmosphere, during this time, was strongly impregnated with the peculiar odour which emanates from the species."

Though not entirely to the point we are considering, we willingly yield to the temptation of inserting a striking passage which occurs in this account:—"I cannot describe to you the extreme beauty of their aerial evolutions, when a hawk chanced to press upon the rear of a flock. At once, like a torrent, and with a noise like thunder, they rushed into a compact mass, pressing upon each other toward the centre. In these almost solid masses, they darted forward in undulating and angular lines, descended, and swept close over the earth, with inconceivable velocity, mounted perpendicularly, so as to resemble a vast column, and, when high, were seen wheeling and twisting within their continued lines, which then resembled the coils of a gigantic serpent."

These flights are, doubtless, in search of food, and may throw some light on the nature of the principle by which migrations are influenced, as they are obviously

regulated by an impulse, if not observing and intelligent, at least capable of being adapted to new circumstances, and of taking advantage of new discoveries. Catesby mentions, that since the discovery of America has introduced crops of foreign grain into that once savage and uncultivated country, not only have these comparatively novel articles of food become the familiar resort of native birds from distant regions, but that various species of the winged tribes, naturally strangers to that continent, have, by some means, become aware of the existence of such exotic stores, and arrive annually in numerous flocks, at the proper season, to avail themselves of this new provision for their wants. The rice-bird and the wheat-bird are of this description. The latter, if Catesby's observations be correct, has taken this new course of migration across the sea from the Island of Cuba, between one and two hundred miles distant from the nearest point of the mainland, leaving that region immediately after the rice harvest, and alighting in Carolina in time to partake of the rice crop in that later climate, and afterward of the ripening wheat in the more northerly plains of Virginia. It is, indeed, but a few years since the wheat-birds first found their way to this latter State, where they now regularly flock at the proper season, in such numbers, as materially to interfere with the gains of the farmer.

This is a very interesting view of the nature of the winged family, and gives rise to some curious and difficult questions. By what means do birds ascertain the introduction of their proper food into these new and distant regions? How do they communicate the information to their fellows, after they have obtained it? And when once known, by what faculty is it perpetuated in the individuals, and transmitted to their posterity? Are we to believe that, like man, they make distant voyages of discovery in search of new stores; that they possess a faculty resembling that of speech, by which they convey a knowledge of the discoveries they have made; and that

they are furnished with memories sufficiently retentive, and reasoning powers sufficiently strong, to enable them, from year to year, as the season returns, to profit by the new knowledge they have acquired? This seems to be Catesby's opinion; and it would, doubtless, readily account for these and various other phenomena of a similar nature, which may occur to the inquiring mind; but it seems to be so inconsistent with what is known of the limited mental powers of birds, that it will not readily be assented to, and we must, probably, look for the true solution in some qualities bearing more resemblance to the admitted faculties of the race. If, however, we attempt to pursue the inquiry farther, we shall, perhaps, here, as in a thousand other instances, land ourselves in perplexity and darkness, and be forced to rest in the humbling conviction, that such knowledge is too high for us. When we become aware that the migratory impulse varies according to circumstances, and is modified by changes in climate or in food, whether dependant on natural causes or on the labours of civilized man, we seem to have acquired a glimmering of something like a principle of reason as applicable to that impulse. But when, on the other hand, we consider the extent to which that reasoning principle must necessarily be carried, before it can account for the phenomena,—when we recollect, that it must include some high powers of memory, reflection, and judgment, as well as considerable geographical knowledge, and an accurate acquaintance with the progress of time, as connected with the changes of the seasons and the ripening of the fruits of the earth, it seems altogether impossible to maintain this ground, and we feel compelled to fall back on our first conclusions, and to resolve the whole, or at least by far the greater part, into a power, the nature of which has hitherto eluded all attempts to analyze it, and our ignorance of which we endeavour to conceal under the name of instinct.

Here, then, we find new cause to look up with awe

and adoration to the mysterious but beneficent operations of that unseen, omnipresent Intelligence, who causes "the stork in the heaven to know her appointed times, and the turtle, and the crane, and the swallow, to observe the time of their coming."

EIGHTH WEEK—THURSDAY.

HYBERNATION.—MIGRATION OF QUADRUPEDS.

The care of Providence in securing the subsistence and comfort of quadrupeds in the winter months, is not less remarkable than that which is displayed toward the feathered creation; and the modifications of their hybernating instincts, and of other arrangements, exhibit equal indications of wise and beneficent design. A striking example of that adaptation of propensities to external circumstances, which is to be found characterizing the instincts of all the orders of organized beings, occurs among the brute tribes, in the limited extent of their migratory habits. Being destitute of wings, which transport the various species of birds so expeditiously and safely through the air, they cannot leave their native haunts without difficulty and danger, arising from the rugged and intersected nature of the earth to which they are confined, and the fury of the enemies they would meet with in a journey necessarily tedious, and often unsheltered. Some quadrupeds, however, do possess this instinct in situations favourable for its exercise. In our own island, for example, the stag and the roebuck leave the higher regions on the approach of winter, and seek protection in the more sheltered plains. But it is in continental countries, where larger space is afforded, and where the variety of climate gives freer scope for the development of the principle, that migratory habits are to be chiefly expected, and it is there that they actually

exist to the greatest extent. I shall confine myself, on this subject, to the quotation of an interesting passage in Mr Kirby's Bridgewater Treatise, which occurs under the head of Geographical Distribution of Animals:—

"We are next to consider those migrations that take place periodically, and usually at certain seasons of the year; the general intention of which appears to be a supply of food, and often a temperature best suited to reproduction; Providence, in this, taking care, that their instincts shall stimulate them to change their quarters, when these two objects can be answered at the same time, and by a single removal.

"In North America, that ferocious and lion-like animal, the bison, called there the buffalo, forms regular migrations, in immense herds, from north to south, and from the mountains to the plains; and, after a certain period, returns back again. Salt springs, usually called salt-licks or salines, found in a clay compact enough for potter's clay, are much frequented by these animals; whence they are called buffalo salt-licks. Dr Richardson informs me, that the periodical movements of these animals are regulated almost solely by the pastures; when a fire has spread over the prairies, it is succeeded by a fine growth of tender grass, which they are sure to visit. How the bison discovers that this has taken place, seems not easily accounted for; perhaps stragglers from the great herds, when food grows scarce, may be instrumental to this.

"The musk-ox, a ruminating animal, between the ox and sheep, has the same habit, extending its migratory movements as far as Melville, and other islands of the Polar Sea, where it arrives about the middle of May; and going southward toward the end of September, where it has been seen as low as latitude 67° N., which, as Dr Richardson observes, approaches the northern limit of the bison. Its food, like that of the rein-deer, or *caribou*, is grass in the summer, and lichens in the winter. Its hair is very long; and,—as well as that of the

bison, which has been manufactured, both in England and America, into cloth,—might be woven into useful articles. This animal inhabits, strictly, the country of the Esquimaux, and may be regarded as the gift of a kind Providence to that people, who call it *oomingmak*, and not only eat its flesh, but also the contents of its stomach, as well as those of the rein-deer, which they call *norrooks*, which, consisting of lichens and other vegetable substances, as Dr Richardson remarks, are more easily digested by the human stomach when they are mixed with the salivary and gastric juices of a ruminating animal.

"The wild rein-deer, in North America, in the summer, as the excellent man and author lately mentioned states, seek the coast of the Arctic Seas. It is singular, that the females, driven from the woods by the musquitoes, migrate thither before the males, generally in the month of May (some say in April and March); while the latter do not begin their march till toward the end of June. At this time the sun has dried up the lichens on the barren grounds; and the moist pastures in the valleys of the coasts and islands* of the above seas, afford them sufficient food. Soon after their arrival, the females drop their young. They commence their return to the south in September, and reach the vicinity of the woods toward the end of October. After the rutting season, which takes place in September, the males and females live separately; the former retire deeper into the woods, while the pregnant herds of the latter remain in the skirts of the barren grounds, which abound in the rein-deer† and other lichens. In the woods, they feed on lichens which hang from the trees, and on the long grass of the swamps. The males do not usually go so far north as the females. Columns, consisting of eight or ten thousand of these *caribous*, so numerous are

* There seems to be a trifling inaccuracy here. In the month of June, the ice has ceased to bridge the northern seas; and the *males* cannot reach the *islands* if they do not arrive sooner than this period.—H. D.

† Cenomyce rangiferina.—*Achar.*

they in North America, may be seen annually passing from north to south in the spring, infested and attacked in their progress by number of wolves, foxes, and other predaceous quadrupeds, which attack and devour the stragglers.

"The prong-horned antelope,* as well as the rein-deer, appears to go northward in the summer, and return to the south in winter.

"Dr Richardson remarks to me in a letter:—'The musk-ox and rein-deer feed chiefly on lichens, and therefore frequent the barren lands and primitive rocks, which are clothed with these plants. They resort, in winter, when the snow is deep, to the skirts of the woods, and feed on the lichens which hang from the trees; but, on every favourable change of weather, they return to the barren grounds. In summer, they migrate to the moist pastures on the sea-coast, and eat grass; because the lichens on the barren lands are then parched by the drought, and too hard to be eaten. The young grass is, I suppose, better fitted for the fawns, which are dropt about the time the deer reach the coast.' In all this, we see the hand of Providence, directing them to those places where the necessary sustenance may be had."†

Mr Kirby might have added to this latter observation, another, which seems to be not less striking, and which we have already noticed, in reference to some of the winged tribes;—that the chief reason why the rein-deer is taught to seek the north for the birth-place of its young, is, that here the latter are comparatively unmolested by those ferocious beasts of prey, which inhabit the more southerly regions, and which would assuredly greatly diminish their numbers, if they did not entirely exterminate the race, were the fawns to reside in the neighbourhood of these hordes of enemies, before they had acquired sufficient swiftness and strength to elude pursuit. This provision of Providence is truly wonderful. At the time appointed for the dropping of their young, the food

* Antelope furcata. † Kirby's Bridgewater Treatise, vol. i. p. 94.

of the rein-deer, as well as of the musk-ox, is to be found in abundance, at a distance from the chief haunts of their natural enemies; and thus these peaceful tribes are led, by a kind of double instinct, to the preservation of their species, both as regards its maintenance and reproduction.

In speaking of the migrations of the rein-deer, I must not omit to mention a striking peculiarity, which belongs to this as well as some other of the more intelligent species of animals: their motions appear to be directed by leaders of their own species, whom they implicitly obey, and who head their march. As they are gregarious animals, such an instinct must be exceedingly useful to them, in the unfrequented wildernesses through which they travel. They will thus profit by the experience of their captain, who is always probably one of the oldest and most knowing of the herd; for, that many of the inferior animals do learn by experience, and thus show a sagacity above mere instinct, it is impossible to doubt. The same subjection to leaders, in their movements, is observable in the elephant. The Hottentots told Mr Pringle, that, in the dense thorny forests, the great bull elephants always march in the van, bursting through the jungle, treading down the prickly brushwood, and breaking off with their trunks the larger branches that obstruct their passage, while the females and younger part follow them in single file.

That the younger or more feeble should voluntarily subject themselves to the guidance of the stronger, indicates a fine instinct; but it is not so surprising in the case of the elephant, where it would appear that *all* the largest males of the herd take the precedence, as it is in the instance of the rein-deer, who seem to select a single leader, and obey him, as if he were invested with lawful authority. By what principle, whether of instinct or of something approaching nearer to the faculty of reason, this sagacious race look up, with common consent, to one individual of the herd, it seems difficult to determine;

but, however this may be, it does not less display the paternal care of the Creator. Something approaching to the same habit, is found in other gregarious animals. The Mongalian antelopes have their leader, whom they follow in regular files. The old ram of the flock,—the bull among the kine,—the dunghill-cock, who has proved his superior prowess and courage,—each, in its own department, exercises a sway,—approaching, in the last mentioned, to a species of petty despotism,—which indicates an inferior degree of the same principle. Indeed, were we better acquainted with the habits of gregarious animals, the remarkable property of subjection to a superior, would probably be found to be far more extended, than may at first sight appear; for, wherever living beings congregate and act in concert, some presiding intellect, if not absolutely necessary, is yet of great utility; and it is a new instance of the wisdom and benevolence of the Creator, that, where He has been pleased to bestow the social instinct, He should also have so generally bestowed a quality, by which the peace and welfare of the respective communities are essentially promoted; and that, among the various tribes of lower animals, from the mighty elephant to the tiny bee,—the most wonderful of them all,—the important principle of subordination should be so widely diffused.

EIGHTH WEEK—FRIDAY.

CHRISTMAS-DAY.

This day is usually consecrated to the remembrance or solemn celebration of our blessed Lord's nativity. Though not disposed to look with favour on the pompous ceremonials with which it is greeted by several branches of the church, even were it clearly proved to be the true anniversary, we yet deem it a profitable and pleasing

duty to turn our thoughts this morning to the great event that occurred at Bethlehem, and that was destined to usher in the dawn of our glorious day.

Who, then, was He that was born at Bethlehem, and whose birth was attended by every circumstance of poverty and meanness? The humble mother, the lowly stable, the manger, the poorness and obscurity of the place, the absence of all public rejoicing, declared it to be no earthly prince that was born, the joy of his sceptered father, and the hope of nations; but only an infant who might, in future years, have nowhere to lay his head, and might live and die unknown Herein lay the humiliation of God's incarnate Son. Yet the bursting of Heaven's gates, at the midnight hour; the glad announcement to the awe-struck shepherds; and the enraptured song of the heavenly host singing, "Glory to God in the highest, and on earth peace, good-will toward men;" the miraculous star, and the wise men of the East bringing costly gifts, and offering them in lowly adoration,—proclaimed the advent of that celestial King who was to rule in Zion, even of the beloved Son of God, in whom He was well pleased. Humble was the guise in which the Messiah appeared, and unheeded by a sinful world the hour of His birth; but a few rays of His glory were permitted thus early to shine forth, and declare to a chosen band the secret of His greatness. The tongue of man was silent on that most joyful of all occasions; but angel harps were visibly struck to celebrate the new-born Saviour of Mankind.

And what was the life, on earth, of Him who thus came in glory and humiliation? It was that of a deliverer of man. But did He overturn the thrones of blaspheming tyranny, and hurl to the dust, with an arm of physical power, the vain pride of mortals? Did he trample down the haughty and the great, and exalt the humble poor? Did He take signal vengeance upon the crafty and blood-stained ministers of idolatry, and vindicate the majesty of Jehovah by the visible overthrow of their hideous

altars and shrines? No; though the greatest of deliverers, He did none of these things. He was the meekest of the sons of men. He went about continually doing good; and, wherever He went, He scattered the heavenly light of truth. Along with the benevolence and the wisdom, He displayed also the power of the Godhead. He proclaimed to all that would come unto Him, the forgiveness of sins; and he healed the most loathsome and fatal bodily diseases, in token of His power to heal the great maladies of the soul. He came to overthrow the kingdom of Satan, and He showed His ability to achieve the mighty deed, by casting out the unclean spirits which executed the purposes of that evil power. It was also His office "to bring life and immortality to light;" and to prove, by the clearest evidence, that resurrection which He taught, He raised the dead corpse, already mouldering in its decay, and gave back the lost and the lamented to their weeping friends. He poured on the sightless eyeball the light of day, and on the long benighted soul the cheering radiance of mercy and truth. Every word and action showed His love to man, and was fraught with the sublimest meaning.

Such was the life of the Redeemer, as it is recorded by His chosen followers,—a life which, though sketched, as it were, in outline, yet carries upon it the significant stamp of divinity. A celebrated infidel,* apparently overpowered, for the moment, by the moral beauty and harmony of the New Testament, in one of his works, declares that "the inventor of the Gospel would be a more astonishing character than the hero." A nobler or more striking sentiment could scarcely have proceeded from the lips of a believer in our holy faith. Yes! the character of Jesus was unimaginable by mortal man. That humility, sustained by Divine dignity; that benevolence, so free from ostentation; that prudence, so nobly allied to courage; that compassion for human suffering, so far removed from any tolerance of human sin; that patience

* Rousseau.

and benignity; that holiness and love, which adorned the Saviour's walk on earth,—lay entirely beyond the reach of finite conception. It is the province of imagination, when called into play by some powerful emotion, to form sublime or beautiful ideal pictures, out of the stores furnished by our perception of material things; to preside over the creations of the painter or the poet, who study nature and human life, in order to supply their prevailing mental power with appropriate imagery. Imagination can only arrange into new combinations the ideas drawn from this living world; its range is limited by our experience; the groups and images it creates may be new, but the constituent parts of these are solely derived from what we see and hear. Magnificent and glowing may be the ideal scenery it draws,—of superhuman excellence the moral hero that it places before the eye of the mind; but the elements of the one and of the other are merely of this earth, and are marked with the imperfection and mortal stain of all things earthly. The fine creations of a Virgil or a Plato, are palpably but the imaginings of beings with limited faculties, and corrupt moral natures, whose experience is only mundane, and whose fancy is fed with the imagery of a fallen world. Who, then, *could* have conceived the character of the Son of God, manifested on earth, in human form? The materials of such a conception were unknown. They lay in the bosom of the Eternal Father, unseen, unheard of, by mortal eye or ear. Beyond the reach of the most seraphic imagination, they never could have been embodied and presented to the filmed vision of man, by any of his race. How could that Divine love, which glowed in the bosom of Jesus of Nazareth, have been imagined by one in whose heart dwelt pride, hatred, and all evil passions? Can it even yet be fathomed by the loftiest intellect? Into whose mind could it have entered to surround an imagined incarnate God with every circumstance of suffering and humiliation? Who could, in a few simple words, have drawn a picture of the human

heart, the fidelity of which all are at once compelled to own? Who could have opened such a spring of consolation as that unlocked by the man Christ Jesus? Who could have discovered such a simple and efficacious remedy for the great disease of our nature as that contained in the Gospel? Who could have presented such objects to love, such promises to hope, such solemn and elevating mysteries to faith? The Gospel an invention! Jesus Christ a fictitious character! This, unbeliever, would be a miracle of miracles; a phenomenon wholly incomprehensible; at utter variance with all we know of the human mind; plainly transcending, indeed, its loftiest efforts; an inscrutable enigma in the history of man.

Who can describe the consequences of the Redeemer's life and death? The tongues of angels would falter and fail in the attempt. The world, with all its sin and suffering, was permitted to exist, only that Christ might proclaim and complete its salvation; and it still exists, only that it may become the wide theatre of His glory. The light from Heaven that first shone forth among the mountains of Judea, though it has often been obscured, and even disastrously eclipsed, now shines, and will continue to shine, with a far-spreading radiance. Darkness is flying before it. Idolatry is hiding her monstrous head; and nations, at length disenthralled, and joyously surprised, are stretching forth their arms to hail their rising day. The inspired record of redemption is being borne by all the winds of heaven to distant shores; and the church, in sublime hope, is waiting the result. The consequences of the Redeemer's life and death!—Their number and grandeur overpower the imagination. Who shall tell the tears that have been wiped away, the hopes that have been inspired, the guilty passions quelled, and the moral energy infused by the glad tidings of salvation? What tranquil happiness—what sanctifying devotion—what benevolent deeds and aspirations have resulted from the glorious Gospel! And O, how can we contemplate, in thought, the present and the future ran-

somed millions, that shall, through a rapturous eternity, encompass the throne of the Lamb, without being lost in wonder, love, and adoration!

Such are the thoughts that ought to employ us, not only as oft as this joyful anniversary comes round, but as oft as the morning dawns, or the shades of evening close around us. On our Sabbaths, and other solemn seasons, the birth, life, and death of our Redeemer, may be dwelt upon with peculiar and blessed effect; but yet they belong to all times, and afford, on all occasions, appropriate themes of meditation. O, then, let the rising orb of day be ever linked in our minds with the Sun of Righteousness, and let the sweetest star of eve, ever remind us of the Star of Bethlehem! J. D.

EIGHTH WEEK—SATURDAY.

NO SEASON UNPLEASANT TO THE CHEERFUL MIND.

THIS is a period set apart, by almost universal consent, in the Christian world, as a time of festivity. The friendly greetings of the season owe their origin, in a great measure, to religious feelings, although they are very seldom conducted in a religious spirit. There is much reason to regret the abuse, while we cannot condemn the principle on which the enjoyments of this anniversary were originally founded. To the Christian, the advent of the Son of God is indeed "good tidings of great joy;" and when his rejoicings truly take their rise from a grateful and pious recollection of this most glorious event, which was the harbinger of "peace on earth," and the pledge of "good will toward men," it cannot but produce a salutary effect upon the mind.

"There is something in the very season of the year," says Washington Irving, taking another view of the subject, "that gives a charm to the festivity of Christmas.

At other times, we derive a great portion of our pleasures from the mere beauties of Nature. Our feelings sally forth, and dissipate themselves over the sunny landscape, and we 'live abroad and every where;'—the song of the bird, the murmur of the stream, the breathing fragrance of spring, the soft voluptuousness of summer, the golden pomp of autumn,—earth with its mantle of refreshing green, and heaven with its deep delicious blue, and its cloudy magnificence,—all fill us with mute but exquisite delight, and we revel in the luxury of mere sensation. But, in the depth of winter, when Nature lies despoiled of every charm, and wrapped in her shroud of sheeted snow, we turn for our gratifications to moral sources. The dreariness and desolation of the landscape, the short gloomy days, and darksome nights, while they circumscribe our wanderings, shut in our feelings, also, from rambling abroad, and make us more keenly disposed for the pleasures of the social circle."

There is truth in this view, as applicable to a right constituted mind; but, on the temper and feelings of the selfish and querulous, a very different effect is produced. A person of this disposition usually gives way to a feeling of bodily uneasiness, and is visibly disturbed by the coldness and fog of the atmosphere, and the unpleasant state of the ground. He exaggerates the peculiar inconveniences of the season, and invests the gloom of the long-continued storm with his own deeper gloominess. He dwells, with a sort of satisfaction, on every circumstance of annoyance, and rejects every ray of comfort; unlike the more grateful earth, that, in the midst of almost incessant darkness and storm, so soon as the sun scatters for an instant the thick clouds, is kindled into a smile, and seems to anticipate the coming gladness of spring. But these are the symptoms of a mental disease not uncommon at this period, and in this portion of the globe.

Whatever be the cause of this disorder, it is undoubtedly heightened in its virulence by the high notions and

exquisite feeling of *comfort*, consequent upon the great progress of society amongst us, and the still ascending scale of our enjoyments. Our barbarian forefathers, even in the depth of winter, could repose their weary limbs upon a pillow of heath in the open air, gathering, like the oaks of their country, strength and hardihood from the storm. They seemed utterly insensible to the numberless small discomforts that their descendants make or find in the gloomy weather and bleak dominion of winter. They had neither the defences against the inclemency of the season, nor the resources of domestic recreation that we enjoy; and yet we are apt to murmur and complain, as if our circumstances and theirs were exactly reversed. We have secure and comfortable homes, conveniences in clothing and shelter of which they never dreamed, the sweets of refined society, the mental luxury of books, and numerous fascinating amusements, equally innocent and useful; and, notwithstanding these multiplied blessings, we can yield to low impatience and despondency, if, haply, the wintry tempest, however magnificent and sublime in its appearance and effects, hinder our rural excursions, or transiently affect our frames with its moisture and its cold.

Into such ingratitude are we ever disposed to fall. Instead of cultivating cheerfulness at all times and in all seasons, we too frequently lapse into moroseness and melancholy. If, in place of allowing ourselves to be disturbed by any state of the weather or of the country around us, we kept steadily in view the various comforts and enjoyments within our reach at every period of the year, we should only be fulfilling an important duty; and we should also be on the surest way to attain that serenity of mind which is its own reward. A *habit* of cheerfulness would thus be formed, that constitutes no small portion of the philosophy of daily life; and cheerfulness, when once it becomes a habitual feeling, finds food and nourishment in all scenes and seasons. As the man who is keenly alive to the sublime and the beauti-

ful in Nature frequently finds the cherished feelings of his soul ministered unto by objects that to other minds have in them nothing to attract or enliven, so the cheerful mind derives enjoyment from scenery the most unpromising, and perceives, even in the desolation of winter, a beauty and an expression of its own.

It has been said, that the bee extracts honey, and the spider poison, from the same flower; but, perhaps, with greater truth may it be affirmed, that whatever be the condition of the fretful or the self-indulgent, the man of cheerfulness finds the prevailing feeling of his mind reflected back upon him, as it were, from all the varied phenomena of the seasons. He looks at Nature through a medium that has to him all the effects of fabled enchantment. As the eye of the painter or the poet is quick to discern, in every landscape, the subtle elements of his creative art, so does he, by a seeming intuition,—by an almost unconscious alchymy of the mind,—select from the concomitants of every passing season, all that is fitted to compensate his incidental privations, and to inspire that tempered gladness in which his soul delights. The winds of winter may blow coldly over the ravaged earth, and bewail the departed glories of the year; the mountains may be hid from his eye in thickest clouds; the fields and groves may be verdureless and dead; but these only heighten the endearments of his home, and enhance his gratitude for all the blessings congregated there.

I have already dwelt on the peculiar delights of the domestic hearth at this season; and I need not here remark, that these can only be enjoyed in all their power, by the bosom in which contentment and tranquillity reign. The fine enjoyments of home shun the stormy breast, and take up their abode with him who is of a cheerful temper, and who finds, in "all seasons and their change," matter of gratitude and delight. Winter, "stern ruler of the inverted year," may ravage the loved scenery around his dwelling; but, within his own breast,

and in his dear family circle, there reigns a summer of social and domestic joy. The glories of the calm autumnal day may have vanished; but the sublimer glories of the nocturnal heavens more frequently greet his enraptured sight, brightly beaming through the clear frosty air. In the deadness of Nature, he sees her necessary repose before another spring; the rain, the frost, and the snow, are, in his regard, sent by the Almighty Father to fertilize the soil, and herald the bounty of a coming harvest.

Thus it is beneficently ordained, that the happy and contented spirit should find, at all times, the means of enjoyment. The great Framer of the human mind has exquisitely adapted the external world to its various feelings and powers: and when these are in healthful action, Nature, in her wintry as well as her vernal aspects, is full of beauty and harmony. Though the flowery and the fruitful seasons of the year may be over and gone, and the blasts of winter howl among the desolate mountains, the past is without regret, the present full of enjoyment, and the future rich in hope. How should we then adore that Divine goodness, which has given us the power to enjoy the seasons as they pass in grand succession before us; and, even among the sternest scenes of winter, to behold in vision the luxuriant beauty of spring! J. D.

NINTH WEEK.—SUNDAY.

PROOFS OF DIVINE BENEVOLENCE IN THE WORKS OF CREATION.

"CONTRIVANCE proves design," argues Dr Paley; "and the prominent tendency of the contrivance indicates the disposition of the designer. The world abounds with contrivances; and all the contrivances we are acquainted with, are directed to beneficial purposes. Evil, no doubt, exists; but it is never, that we can perceive, the object of contrivance. Teeth are contrived to eat, not to ache; their aching now and then is incidental to the contrivance, perhaps inseparable from it; or even, if you will, let it be called a defect in the contrivance; but it is not the object of it. This is a distinction that well deserves being attended to. In describing implements of husbandry, you would hardly say of a sickle, that it is made to cut the reaper's fingers, though, from the construction of the instrument, and the manner of using it, this mischief often happens. But, if you had occasion to describe instruments of torture or execution, this, you would say, is to extend the sinews; this to dislocate the joints; this to break the bones; this to scorch the soles of the feet. Here pain and misery are the very objects of the contrivance. Now, nothing of this sort is to be found in the works of nature. We never discover a train of contrivance to bring about an evil purpose. No anatomist ever discovered a system of organization calculated to produce pain and disease; or, in explaining the parts of the human body, ever said, this is to irritate; this to inflame; this duct is to convey the gravel to the kidneys; this gland to secrete the humour which forms the gout. If, by chance, he come at a part of which he knows not the use, the most he can say is, that it is useless. No one ever suspects that it is put there to incommode, to annoy, or torment. Since, then, God hath called forth

his consummate wisdom to contrive and provide for our happiness; and the world appears to have been constituted with this design at first, so long as this constitution is upheld by Him, we must, in reason, suppose the same design to continue."*

This is a beautiful, and, in many respects, a just view of the constitution of nature, with reference to living beings; which, while it does not account for the origin of evil, nor vindicate its existence, yet undeniably proves benevolence in the great Creator. Had He been malevolent, we should certainly have met with malevolent contrivances; had He been indifferent to good and evil, we should not have so constantly found, in all the contrivances of nature, a regard to happiness. Still, it must never be forgotten, that the same Divine power, which called such a world as ours into existence, might have formed it free from both moral and natural evil; and this proves, beyond contradiction, that this wise and benevolent Being did not admit the presence of evil, without a wise and benevolent design, whatever that may be. Paley, in his eagerness to vindicate the Divine perfections, seems sometimes to lose sight of that important truth, and to argue as if evil were either an unavoidable incident of creation, or an effect of chance, both of which are obviously untenable positions; and, if such tendency can be discovered in the argument quoted above, I am not inclined to justify it. The fact that all the *contrivances* of Nature are benevolent, so far as they go, is all that I contend for. The existence of evil notwithstanding, is to be accounted for on another principle, the nature of which we can only understand, as I have already stated, by studying the book of Revelation.

Referring to the subject we were considering during the last week, the migration of animals, there can be no doubt, that the Creator, if He had so willed, might have constituted their frames in such a manner as to render winter as profuse of blessings to them, in their native

* Paley's Moral Philosophy, book ii. chap. 5.

haunts, as summer, and thus have prevented the necessity of the long journeys which some of them are impelled to take; that is to say, instead of contrivances to avoid or mitigate evils, He could have removed the evils themselves altogether; and, in their place, have bestowed positive enjoyment. That He has not done so, is one of those striking peculiarities in the Divine administration, of which we can find no adequate solution in natural appearances, and for explanation of which, we must refer to another source. This view has already been stated; but, as it meets us at every turn, and qualifies all our reasonings, it is necessary constantly to recur to it.

Taking the constitution of Nature as we find it, we have abundant reason to perceive indications of goodness, as well as of wisdom, in the migratory propensities which the Creator has so wonderfully impressed on the winged creation, as well as in those contrivances by which the rigour of winter is softened to the various tribes who are not furnished with this resource. Besides the views of this subject already taken, there is another, which ought not to be omitted. There is a pleasure attached, by the Author of our being, to variety. I do not know whether or not this pleasure is felt by the inferior creation; but, assuredly, it is a constituent feature of the human mind. Now, observe one of the provisions made for the gratification of this source of enjoyment, in the changes effected by the migratory habits of birds. The very same swallows, which "twitter from the straw-built sheds" of Britain, during the summer months, delight the swarthy sons of Africa in winter, as they dart after their insect prey, along the plains of that distant continent. The same cuckoo, too, which stopped the little satchelled urchin, on his way from school, in this civilized land, that he might imitate the well known lay, startles the ear of the young African savage, as he roams over his native wilds. The birds of Norway, Sweden, and Iceland, supply the blank made by the retiring of our summer residents; while those which leave

our shores in autumn for the south, probably only occupy the regions left vacant by the transit of the summer visitants of those countries to still more southerly latitudes. Thus a constant interchange of the feathered tribes is kept up, to attract the curiosity, and gratify the love of variety implanted in the heart of man; while these interesting tenants of the air, doubtless, fulfil another benevolent intention of their Creator, by feeding on the insects which the warm climates so abundantly produce; thus providing against their increase, to such undue extent, as to destroy, or materially to injure, animals of a higher grade, and disturb the beautiful balance of Nature.

But, in regarding the provisions of the God of Nature for the welfare of the animated creation during this comparatively dismal season, and tracing the hand of a beneficent Parent in the tender care which He manifests for their subsistence and comfort, we can scarcely avoid extending our thoughts farther, and raising them higher. The beautiful language of our Saviour, which affords so just and so encouraging a view of the Universal Parent, naturally occurs, in such a review, to the pious mind:—"Behold the fowls of the air; for they sow not, neither do they reap, nor gather into barns; yet your heavenly Father feedeth them. Are ye not much better than they?" Better, assuredly, in our moral and intellectual powers, if only these be properly employed; and the sentiment points obviously to the higher destiny, to which, as immortal beings, we are called, by Him who brought life and immortality to light.

The migration of birds to fairer climes, when the storms of winter gather, cannot, indeed, be said to furnish any analogy, on which we can build a solid argument for the existence of a future state; but yet there is something in the paternal feeling which it indicates, that, at least, forcibly recals the promised blessing to the mind, and affords an agreeable illustration of the revealed truth.

We can fancy the bird, borne by a secret impulse from the coming gloom and sterility of its native haunts, winging its way over sea and land, looking down with indifference on the placid expanse of the ocean, or rising far above its stormy waves; gliding, without the desire of rest or food, over flowery plains and wide-spread wastes, forests, lakes, and mountains; fixing its eager eye on the distant horizon; still onward—onward keeping its steady course; and giving no rest to its buoyant wings, or at least none except what Nature loudly demands, till it reach the happy shore, to which an unseen hand was guiding it, and a voice, unheard by the outward ear, was whispering all the while, "Behold the place of your rest." All this, which every recurring year realizes, we can paint to ourselves, and we can see, in that wonderful flight, an emblem of the race of the pious Christian, who seeks his rest in heaven. The same unseen hand is guiding him from the storms of earth, the same unheard voice communicates inwardly with his conscious soul; with a similar desire he burns; with a corresponding eagerness he pants;—but his view is not bounded by a horizon of earth; his hopes are far, far beyond the regions of the sun: To the distant heavens he directs his anxious gaze; before him still he sees a bloody track, and knows the footmarks of his crucified Redeemer; dim in the distant sky, a shining spot appears; on that spot his anxious eye is fixed; it brightens and enlarges as he advances; one struggle more;—the ties which bound him to the world are broken;—earth disappears;—he enters the portals of heaven;—he is in the arms of his Saviour—he is singing hosannahs with angels and blessed spirits before the throne of God!

NINTH WEEK—MONDAY.

MIGRATION OF FISHES.

There is yet another class of migratory creatures, which we take notice of here, although their annual journeys are not so immediately connected with temperature, and the means of subsistence, as those we have already mentioned, and although these journeys do not properly belong to this season of the year;—I allude to the inhabitants of the seas. There is indeed one analogy, by which those numerous classes are connected, in their change of place, with the migratory animals of the land—that of the instinct by which they seek for a fit place for the reproduction of the species. That this is at least one of the laws which regulate the removals of birds and beasts, Dr Jenner has very distinctly and ingeniously proved,*—showing that, when the stimulus connected with propagation is felt, they commonly seek their *summer* quarters, and, when it ceases, retire to their *winter* haunts. To whatever extent this may be the case with land animals, there can be no doubt, that such a law has a most powerful effect on those which glide through the waters of the great deep.

Of migratory fishes, the sturgeon, and its gigantic congener, the huso, are well known. This latter species is only to be found in the Caspian and Black Seas, and the rivers which flow into them. It enters the Don and Volga, in vast shoals, about the middle of winter, where it spawns, and then returns to its usual places of summer resort. The prodigious fertility of this fish, may be judged of by the circumstance, that its eggs equal nearly a third of its whole weight; and Pallas, who gives an interesting account of the mode of fishing the huso, men-

* In a paper, published after his death, in the Philosophical Transactions for 1824.

tions one which weighed no less than 2800 lbs. Of these eggs the caviare is made, which is in great demand, as an article of food, among the Russians and Turks, and on which the Greeks are said almost entirely to subsist, during their long fasts.

The cod-fish, the haddock, and the mackerel, are also different species of migratory fishes. The former of these frequents shallows and sand-banks, between the 40° and 68° of north latitude, both in the Atlantic and Pacific oceans, and is taken in immense numbers, especially on the banks of Newfoundland. This fish makes for the coast at spawning time, which takes place about the end of winter. It is said by Leuwenhock, that there are more than nine millions of eggs in a cod-fish of the middle size. What a bountiful provision for the numerous tribes of the broad ocean, which exist by devouring the fry, &c., as they rise to maturity!

But, of all the inhabitants of the ocean, the herring is the most valuable, as affording the greatest quantity both of profitable employment, and of food to man. Three thousand decked vessels, of different sizes, besides smaller boats, are stated to be employed in the herring fishery, with a proportionable number of seamen, besides many thousands of hands, who are, at certain seasons, employed in curing them. Of this fish, Kirby gives the following interesting account.

"The *herring*, to which I now allude, belongs to the tribe called *abdominal* fishes, or those whose ventral fins are behind the pectoral, and may be said to inhabit the Arctic Seas of Europe, Asia, and America, from whence they annually migrate, at different times, in search of food, and to deposit their spawn. Their shoals consist of millions of myriads, and are many leagues in width, many fathoms in thickness, and so dense, that the fishes touch each other; they are preceded, at the interval of some days, by insulated males. The largest and strongest are said to lead the shoals, which seem to move in a certain order, and to divide into bands as they proceed,

visiting the shores of various islands and countries, and enriching their inhabitants. Their presence and progress are usually indicated by various sea birds, sharks, and other enemies. One of the cartilaginous fishes, the sea ape,* is said to accompany them constantly, and is thence called the king of the herrings. They throw off, also, a kind of oily or slimy substance, which extends over their columns, and is easily seen in calm weather. This substance, in gloomy, still nights, exhibits a phosphoric light, as if a cloth, a little luminous, were spread over the sea.

"Some conjecture may be made of the infinite number of these invaluable fishes, that are taken by European nations, from what Lacepede relates,—that, in Norway, 20.000,000 have been taken at a single fishing; that there are few years that they do not capture 400,000,000; and that, at Gottenburgh, and its vinicity, 700,000,000 are annually taken. 'But what are these millions,' he remarks, 'to the incredible numbers that go to the share of the English, Dutch, and other European nations?'

"Migrations of these fishes are stated to take place at three different times; the first, when the ice begins to melt, which continues to the end of June; then succeeds that of summer, followed by the autumnal one, which lasts till the middle of September. They seek places for spawning, where stones and marine plants abound, against which they rub themselves, alternately on each side, all the while moving their fins with great rapidity." †

The instincts and habits of the finny tribes are necessarily less known than those of the inhabitants of the land, where their motions are constantly under the eye of man; but all that we do know of them, proves that the same wonder-working and beneficent Power, which watches over, and so mysteriously guides, the living creation in the regions of earth and air, extends his go-

* Chimaera monstrosa.

† Kirby's Bridgewater Treatise, vol. i. pp. 113-115.

vernment and his paternal care to the vast ocean, adapting the various natures of the creatures, with which he has so abundantly peopled it, with consummate wisdom, to the element in which they are destined to move; providing for their reproduction, their subsistence, and their happiness, in a manner analogous to, and yet different from, that of the land tribes; and, both in their analogy and their difference, exhibiting a skill transcending all adequate expression, and filling the mind with astonishment and awe. No wonder that the psalmist, even with his comparatively limited knowledge, should express his admiration in this glowing strain:—"O Lord, how manifold are Thy works! In wisdom hast Thou made them all. The earth is full of Thy riches; so is this great and wide sea, wherein are things moving innumerable, both small and great animals. There go the ships; there is that leviathan, whom Thou hast made to play therein. These all wait upon Thee, and Thou givest them their meat in due season."

NINTH WEEK—TUESDAY.

Of the migratory inhabitants of the ocean, the most remarkable is that class of which the whale is the chief. As there are animals of a low grade, which, by their structure and amphibious habits, seem intended, by the Author of Nature, to form the link between the denizens of the land and of the sea, so it has pleased Providence to place at the top of the scale of creatures whose "home is in the deep," a gigantic race, so nearly allied to the inhabitants of the land, that many naturalists have denied it the name of fish, and have bestowed on it the some-

* For a great part of this paper, I have to acknowledge my obligations to Dr Bushnan, the intelligent author of the "Introduction to the Study of Nature."

what awkward appellation of "beast of the ocean." Animals of this genus resemble quadrupeds, indeed, as to their structure, in many striking particulars. Like quadrupeds, they have lungs, a stomach, intestines, liver, spleen, and bladder. Like quadrupeds, too, they have a heart, with its partitions, driving warm and red blood in circulation through the body; they breathe the air; they are viviparous; and they suckle their young at the teat. Their internal parts, which bear so close a resemblance to land animals, are similarly protected from the cold, being covered, like the hog, between the skin and the muscles, with a thick coat of fat or blubber. It is this latter property which renders them valuable to man, by whom they are so pertinaciously hunted, that it is believed not one of the largest species dies a natural death in our northern seas, or arrives nearly at its natural size.

Notwithstanding their close resemblance to quadrupeds, however, in so many particulars, they are not less closely connected with the families of the sea. They are shaped as fishes; they swim with fins; they are entirely destitute of hair; they live wholly in the depths of the ocean,—qualities which, although the whale order is justly ranked by naturalists among Mammalia, have procured for them, in ordinary language, that distinctive name, by which we distinguish the finny tribes.* The various species of this animal are—the whale, and its varieties, the cachalot, the dolphin, the grampus, and the porpoise.

These cetaceous animals, as they require to breathe the air, have holes at the top of their head, called spiracles, corresponding to the nostrils of land animals, which they frequently raise above the surface of the water, and through which the air finds access to their lungs. It is through these orifices that the water-spouts of the whale are ejected, accompanied with a noise, loud as a rushing torrent, and rising sometimes to the height of forty feet.

* Goldsmith's Animated Nature.

These spouts, which have occasioned much discussion, consist merely of expired air, and watery vapour, condensed by the cold of the atmosphere, in the same manner as we see, in a frosty morning, our own breath similarly affected.

Whether we rank the whale among beasts or fishes, he is superior to all other warm-blooded animals, both from the extent of the domain, which he has held uninterrupted from the beginning of time, and from the enormous size to which he attains.* The hippopotamus, the elephant, the crocodile, are pigmies to him; and, while they cower before the blast, he plays with the storm-vexed ocean, mounts carelessly upon the giant waves, lies like a cradled creature 'mid their dark and dismal furrows, and, defying the power of the most tempestuous seas, sinks in security to the deep profound. The strength of the whale, too, is prodigious. "A large boat," says Martins, in his voyage to Spitzbergen, "he valueth no more than dust; for he can beat it to shivers at a blow." The blows of the tail of the white shark, when hauled upon the decks of a vessel, are so tremendous, as to threaten destruction to all on board; and, while in the water, the basking shark, when harpooned, has been known to tow a vessel of seventy tons burden, at a rapid rate, against a fresh gale, for a considerable distance.

Against these mighty animals, man wages a war so exterminating, as to have driven them from their ancient haunts, to seek for safety in the more inaccessible parts of the ocean: here, however, they are followed, to obtain the great quantity of oil which is found in what is called their blubber. The quantity of this oil, procured from the great northern whale, frequently amounts to one-twelfth of the weight of its enormous carcase; the tongue alone, which has been said to be "about the size

* The whale is said to have been found, formerly, of the amazing size of 200 and even 230 feet; but it seldom is permitted, in the present day, to escape the rapacity of man, after it has attained the length of 70 or 80 feet, except in the South Seas, where it may still be occasionally taken of double that size.

of a great feather-bed," often yielding five or six barrels. Besides this mass of subcutaneous fat, many cetaceous animals, as the bottle-nosed or spermaceti whale, have a second collection of a similar substance, except that it is of a purer quality, and firmer consistence, in a large reservoir, often 16 or 18 feet long, and wide in proportion, at the top of their heads, near the spiracles or breathing-holes. This is the spermaceti of commerce.

Here we have a strong illustration of the all-provident care of the Almighty. The solid parts of the body of these animals are heavier than water; consequently, had they not been provided with a sufficient supply of some substance lighter than water, by which their tendency to sink might be counteracted, it would have required a constant effort, on their parts, to keep themselves at any given level below the water; and not only this, for cetaceous animals, unlike other fishes, require frequently to be raised to the surface. So, while the oil of the blubber serves to render the body, collectively, lighter than the water which they inhabit, the spermaceti serves to render the top of the head the most buoyant part of the body; and, in this way, it is kept above the surface, without any exertion.

We are indebted to Captain Scoresby for the following interesting notices of the Greenland Whale Fisheries:—

The first impulse of the whale, when harpooned, is to plunge deep beneath the waves, going at the rate of eight or ten miles an hour, and carrying the harpoon, to which a long line is attached, still fixed in the wound. The depth to which it sometimes plunges, is 800 fathoms, and the pressure there sustained would, according to this scientific writer, be equal to 211,200 tons,—a degree of pressure, of which we have but an imperfect conception. "It may assist our comprehension, however, to be informed, that it exceeds in weight sixty of the largest ships of the British navy, when manned, provisioned, and fitted for a six months' cruize."

"No sooner does the exhausted whale appear, than

the assisting boats make for the place, with the utmost speed, and, as they reach it, each harpooner plunges his harpoon into its back, to the amount of three, four, or more, according to the size of the whale, and the nature of the situation. Most frequently, it descends for a few minutes after receiving the second harpoon, and obliges the other boats to wait its return to the surface, before any farther attack can be made. It is afterward actively plied with lances, which are thrust into its body, aiming at its vitals. At length, when exhausted by numerous wounds, and the loss of blood, which flows from the huge animal in copious streams, it indicates the approach of its dissolution, by discharging from its blow-holes a mixture of blood, along with the air and mucus which it usually breathes out, and finally, jets of blood alone. The sea, to a great extent around, is dyed with its blood, and the ice, boats, and men, are sometimes drenched with the same. Its final capture is, at times, preceded by a convulsive and energetic struggle, in which its tail, reared, whirled, and violently jerked in the air, resounds to the distance of miles."

This animal exhibits such warm affections for its mate and its young, as to excite the strongest sympathy for its fate, in the benevolent mind; and this feeling is certainly not diminished by the circumstance, that these very affections are frequently made use of, by the heartless avarice of man, to decoy it into his power. Captain Scoresby mentions, that the cub is often attacked to lure the mother, and, when this cruel plan is adopted, it generally succeeds. "In June 1811," says he, giving an example, "one of my harpooners struck a sucker, with the hope of its leading to the capture of its mother. Presently she arose close by the fast-boat, and, seizing the young one, dragged about 100 fathoms of line out of the boat, with remarkable force and velocity. Again she arose to the surface, darted furiously to and fro, and frequently stopped short, or suddenly changed her direction, and gave every possible intimation of extreme

agony. For a length of time, she continued thus to act, though closely pursued by the boats; and, inspired with courage and resolution, by her concern for her offspring, seemed regardless of the danger that surrounded her. At length one of the boats approached so near, that a harpoon was hove at her; it hit, but did not attach itself. A second harpoon was struck; this also failed to penetrate; but a third was more effectual, and held. Still she did not attempt to escape, but allowed other boats to approach; so that, in a few minutes, three more harpoons were fastened; and, in the course of an hour afterward, she was killed."

There is something exceedingly interesting in the fact, that, in these monsters of the ocean, the hand of the Creator has placed the same kindly and disinterested affections, which ennoble the most exalted of his creatures who tread the solid land, and claim kindred with hea-

NINTH WEEK—WEDNESDAY.

MIGRATION OF FISHES FROM THE SEA INTO RIVERS.

With regard to the tenants of the ocean which periodically find their way into the fresh water, for the purpose of spawning, Mr Kirby gives the following interesting notices:—

" The next tribe of migratory fishes, is one whose several species are intermediate between marine and fresh water fishes, roving, indifferently, in the sea, and rivers, and lakes, and thus is fitted, by Providence, to make up to the inhabitants of inland countries their distance from the other migrators, by a supply, brought, as it were, to their very doors. The fishes in question, belong, like the herrings, to the abdominal class, and form the salmon genus, ncluding the salmon, the salmon-trout, the trout,

the grayling, the char, the smelt, the hucho, and many other species. I shall, however, confine my observations principally to the king, as it may be called, of the river migrators,—the *salmon*. In our own country this noble fish is too high priced to form a general article of food, and may be reckoned among the luxuries of the rich man's table; but in others, especially amongst some of the North-western American tribes, they are gifts of Providence, which form their principal food at all seasons. One, which Sir George Mackenzie fell in with, in his journey from Canada to the Pacific, were perfect ichthyophagites, and would touch no other animal food.

* * * * *

"The salmon, indeed, frequents every sea, the Arctic as well as the Equatorial; and it is found even in great lakes and inland seas, as the Caspian, into which it is even affirmed to make its way by a subterranean channel from the Persian Gulf;* it goes as far south as New Holland and the Australian Seas; but it is said never to have been found in the Mediterranean, and appears to have been unknown to Aristotle. Pliny mentions it as a river fish, preferred to all marine ones by the inhabitants of Gaul. It traverses the whole length of the largest rivers. It reaches Bohemia by the Elbe, Switzerland by the Rhine, and the Cordilleras of America by the mighty Maragnon, or river of the Amazons, whose course is nearly 3000 miles. In temperate climates, the salmon quits the seas early in spring, when the waves are driven by a strong wind against the river currents. It enters the rivers of France, in the beginning of the autumn—in September; and in Kamtschatka and North America still later. In some countries this is called the salmon-wind.

"They rush into rivers that are freest from ice, or where they are carried by the highest tide, favoured by the wind; they prefer those streams that are most

* It is somewhat surprising to see this ridiculous fable gravely mentioned even as a report, by so judicious a naturalist as Mr Kirby.

shaded. They leave the sea in numerous bands, formed with great regularity. The largest individual, which is generally a female, takes the lead, and is followed by others of the same sex, two and two, each pair being at the distance of from three to six feet from the preceding one; next come the old, and after them the young males, in the same order.

"The noise they make in their transit, heard from a distance, sounds like a far-off storm. In the heat of the sun, and in tempests, they keep near the bottom; at other times, they swim a little below the surface. In fair weather they move slowly, sporting as they go, at the surface, and wandering again and again from their direct route; but, when alarmed, they dart forward with such rapidity that the eye can scarcely follow them. They employ only three months in ascending to the sources of the Maragnon, the current of which is remarkably rapid, which is at the rate of nearly forty miles a-day; in a smooth stream, or lake, their progress would increase in a fourfold ratio. Their tail is a very powerful organ, and its muscles have wonderful energy; by placing it in their mouth, they make of it a very elastic spring; for, letting it go with violence, they raise themselves in the air to the height of from twelve to fifteen feet, and so clear the cataract which impedes their course; if they fail in their first attempt, they continue their efforts till they have accomplished it.* The female is said to hollow out a long and deep excavation in the gravelly bed of the river, to receive her spawn, and, when deposited, to cover it up; but this admits of some doubt.

"Among the migrations of fishes, I must not neglect those which take place in consequence of the water in the ponds or pools that they inhabit being dried up. Some of these are very extraordinary, and prove, that

* If it be true that the salmon which frequents the waters of the Maragnon can clear a cataract of fifteen feet in height, in the manner stated by Mr Kirby, it must be a much more powerful and active fish than the species found in the British rivers.

when the Creator gave being to these animals, he foresaw the circumstances in which they would be placed, and mercifully provided them with the means of escape from dangers to which they would be necessarily exposed.

"In very dry summers, the fishes that inhabit the above situations, are reduced often to the last extremities, and endeavour to relieve themselves, by plunging, first their heads, and afterward their whole bodies, in the mud, to a considerable depth. * * *

"But others, when reduced to this extremity, desert their native pool, and travel in search of another that is better supplied with water. This has long been known of eels, which wind, by night, through the grass, in search of water, when so circumstanced. Dr Hancock, in the Zoological Journal, gives an account of a species of fish, called, by the Indians, the flat-head hassar, and belonging to a genus* of the family of the Siluridans, which is instructed by its Creator, when the pools in which they commonly reside, in very dry seasons, lose their water, to take the resolution of marching by land, in search of others in which the water is not evaporated. These fish, which grow to the length of a foot, travel in large droves with this view; they move by night, and their motion is said to be like that of the two-footed lizard.† A strong serrated arm constitutes the first ray of its pectoral fin. Using this as a kind of foot, it should seem, they push themselves forward, by means of their elastic tail, moving nearly as fast as a man will leisurely walk. The strong plates which envelope their body, probably facilitate their progress, in the same manner as those under the body of serpents, which, in some degree, perform the office of feet. It is affirmed by the Indians, that they are furnished with an internal supply of water, sufficient for their journey."‡

* * * *

Mr Kirby mentions some other tribes of migrating

* Doras. † Bipes. ‡ Kirby's Bridgewater Treatise, vol. i. pp. 116–122.

fishes; and, among these, one found in Tranquebar, by Daldorff, which not only creeps upon the shore, but even climbs the fan-palm, in pursuit of certain crustaceans which form its food. Its structure is admirably adapted to this extraordinary instinct. The lobes of its gill-covers are so divided and armed, as to be employed together or separately, as hands, for the suspension of the animal, till, by unsheathing its dorsal and anal fins, which at other times it folds up into the cavity of its body, and, fixing them in the bark, it prepares to take another step.

How curious are these contrivances, and how varied the resources of the Author of Nature! The instances now mentioned, however, are, in reality, no more worthy of attention than the instincts of those animals with which we are most familiar. We are only more surprised and impressed with them, on account of their singularity. The hand of a wonder-working God is every where.

NINTH WEEK.—THURSDAY.

MIGRATION OF EELS.

The following observations of Sir Humphrey Davy, in his "Salmonia," on the migration of eels, are too curious to be omitted:—

"There are two migrations of eels, one *from*, and the other *to*, the sea: the first in spring and summer; the second in autumn, or early in winter. The first, of very small eels, which are sometimes not more than two, or two and a-half inches long; the second, of large eels, which sometimes are three or four feet long, and weigh from ten to fifteen, or even twenty pounds. There is great reason to believe, that all eels found in fresh water

are the results of the first migration.* They appear in millions in April and May, and sometimes continue to rise as late even as July and the beginning of August. I remember this was the case in Ireland in 1823. It had been a cold backward summer; and when I was at Ballyshannon, about the end of July, the mouth of the river, which had been in flood all this month, under the fall, was blackened by millions of little eels, about as long as the finger, which were constantly urging their way up the moist rocks by the side of the fall. Thousands died; but their bodies remaining moist, served as a ladder for others to make their way; and I saw them ascending even perpendicular stones, making their road through wet moss, or adhering to some eels that had died in the attempt. Such is the energy of these little animals, that they continue to find their way in immense numbers to Loch Erne. The same thing happened at the Fall of Bann, and Loch Neah is thus peopled with them. Even the mighty Fall of Schaffhausen does not prevent them from making their way to the Lake of Constance, where I have seen many very large eels.

"There are eels in the Lake of Neufchatel, which communicates by a stream with the Rhine; but there are none on the Leman Lake, because the Rhone makes a subterraneous fall below Geneva; and though small eels can pass by moss, or mount rocks, they cannot penetrate limestone, or move against a rapid descending current of water, passing, as it were, through a pipe. Again, no eels mount the Danube from the Black Sea;

* Mr Mudie, in his volume on the "Sea," observes, that the brackish water at the mouth of rivers is warmer, by two or three degrees, than the water either in the sea itself, or in the river, a circumstance which he accounts for, by the chemical action of the saline substances in the sea on the fresh water. He supposes that eels, and other kinds of fish, resort to estuaries, on account of the warmth; and he adds, that, "in the case of the eel, this heat brings forward the spawn till it is ready to be deposited in the manner in which it is done by the generality of oviparous fishes;" and he considers this to be proved by the fact, "that the young eels are observed ascending the rivers in great numbers, during the following season, while no young eel is, at the same time, found either descending the stream, or crossing the river."—*Mudie's Sea*, p. 68.

and there are none found in the great extent of lakes, swamps, and rivers, communicating with the Danube, though some of these lakes and morasses are wonderfully fitted for them; and though they are found abundantly in the same countries, in lakes and rivers connected with the ocean and the Mediterranean; yet, when brought into confined water in the Danube, they fatten and thrive there.

"As to the instinct which leads young eels to seek fresh water, it is difficult to reason; probably they prefer warmth, and, swimming at the surface in the early summer, find the lighter water warmer, and likewise containing more insects, and so pursue the courses of fresh water, as the waters from the land, at this season, become warmer than those of the sea. Mr Couch says (Lin. Trans., part 14, p. 70), that the little eels, according to his observation, are produced within reach of the tide, and climb round falls to reach fresh water from the sea. I have sometimes seen them, in spring, swimming in immense shoals in the Atlantic, in Mount Bay, making their way to the mouths of small brooks and rivers. When the cold water from the autumnal floods begins to swell the rivers, this fish tries to return to the sea; but numbers of the smaller ones hide themselves during the winter in the mud, and many of them form, as it were, masses together.

"Various authors have recorded the migration of eels in a singular way, such as Dr Plot, who, in his History of Staffordshire, says that they pass in the night, across meadows, from one pond to another;* and Mr Anderson (Trans. Royal Soc.), gives a distinct account of small eels rising up the flood-gates and posts of the water-works of

* There can be no doubt that eels occasionally leave the water for the land. Mr Jesse, who is an accurate inquirer, says, "Eels certainly come upon grass lands, to feed at night upon worms and snails. In the meadows at Barford, in Warwickshire, they have been cut in two by the mowers, and an old keeper there assured a friend of mine, that he had frequently intercepted them, on their way back to the river, early in the morning. Their movements on land were very quick."—*Jesse's Gleanings*, 3d series, p. 68.

the city of Norwich; and they made their way to the water above, though the boards were smooth planed, and five or six feet perpendicular. He says, when they first rose out of the water upon the dry board, they rested a little, which seemed to be till their slime was thrown out, and sufficiently glutinous, and then they rose up the perpendicular ascent as if they had been moving on a plain surface. There can, I think, be no doubt, that they are assisted by their small scales, which, placed like those of serpents, must facilitate their progressive motion. These motions have been microscopically observed by Leuwenhoek (Phil. Trans. vol. iv.).

"Eels migrate from the salt water, of different sizes; but I believe never, when they are above a foot long, and the great mass of them are only from two and a half to four inches. They feed, grow, and fatten, in fresh water. In small rivers they are seldom very large; but in large deep lakes they become as thick as a man's arm, or even leg; and all those of a considerable size attempt to return to the sea in October or November. Those that are not of the largest size, pass the winter in the deepest parts of the mud of rivers and lakes, and do not seem to eat much, and remain, I believe, almost torpid. Their increase is certainly not known in any given time, but must depend on the quantity of their food; but it is probable that they do not become of the largest size, from the smallest, in one or even two seasons. As very large eels, after having migrated, never return to the river again, they must (for it cannot be supposed that they all die immediately in the sea) remain in salt water; and there is great probability that they are then confounded with the conger, which is found of different colours and sizes, from the smallest to the largest, from a few ounces to one hundred pounds weight."

I shall conclude this paper with some observations of Mr Jesse, on the hybernation of eels. "That eels hybernate during the cold months there can, I think, be little doubt, few or none being caught at that time. I have

endeavoured also, but without success, to procure eels in the winter, from those places in the river Thames where, I have every reason to believe, they go to spawn. I read an account which, if correct, would serve to prove what I have now stated. A boy at Arthurstown, in the county of Wexford, perceived something of a very unusual appearance floundering upon the sand at low water. Upon a nearer approach he found it to be a quart bottle, which showed many symptoms of animation. He seized it, and brought it in. It was found to contain an eel so much thicker than the neck of the bottle, that it must be supposed the eel made its lodgement there, when it was younger, and of course smaller. It was necessary to break the bottle for the purpose of liberating the fish.

"If this account be true, it goes to prove, in a curious way, as far as one instance can do so, the propensity which eels have to hybernate during the cold months. It also seems to prove, that they do this in the tide-way if they can, and that they neither feed nor deposit their spawn till the season of hybernation is over. It is indeed a general opinion among old fisherman that eels cannot bear cold."*

NINTH WEEK—FRIDAY.

NEW-YEAR'S-DAY.

It is said to be the custom, in some nations, to mourn at the birth of a child, because of the anticipated evils which it is destined to endure in this vale of tears. This is, doubtless, to form a false estimate of human life, in which, on the average, pleasure far predominates over pain; and surely the contrary custom of rejoicing when another rational and immortal creature is brought into

* Jesse's Gleanings, 3d series, pp. 69, 70.

existence, is much more justifiable. But I am not certain that the same principle will apply to the birth of a new year. There are so many recollections of past delinquencies and omissions, and of losses that can never be repaired, to unite with anticipations of the future—so much to regret as well as to fear,—that the thoughtless levity with which this first day of another annual cycle is generally ushered in, seems to be altogether misplaced. We should certainly do, what is at once more reasonable and more edifying, were we to spend the first hours of a new year in solemn meditation, both on the year which has fleeted away, and on that which has just commenced.

But, in such an exercise, while there is cause of self-accusation and of sorrow, there is also ground for gratitude, for hope, and for enjoyment. The protecting care of an over-ruling Providence, is a fruitful source of these feelings, whether we regard external Nature, or reflect on our own individual experience of the guidance and protection of a Father's unseen hand. It is to the former of these subjects, that the peculiar nature of this work seems at present to call our attention.

When Nature lies clothed in the cold and cheerless mantle of winter, all seems dreary, and desolate, and hopeless.

She is, however, only in a state of repose. Rest was necessary to recruit her exhausted strength. But during her repose, the hand of Him who "slumbereth not," has been working in secret. The germs of future plants and flowers have been wonderfully preserved: insects, reptiles, birds, and beasts, have all partaken of a Father's care; and his rational creatures have been enabled, by employing the higher powers with which He has gifted them, to provide for the supply of their more numerous necessities and comforts.

And now a new scene appears. The sun has changed his course, and begins again to take a wider course in the heavens. Soon his warmth, and glory, and genial

influence will return. Nature will burst anew into life, and beauty, and joy. The husbandman will once more ply his labours, while hope cheers his toil; and, all around, the cattle browse on the tender herbage as it rises, and the bleating lambs play amidst the flocks scattered over the neighbouring hills; and

The lark, high-poised,
Makes heaven's blue concave vocal with his lay.

As the year advances, summer will again smile, and will cast from her green lap a profusion of flowers; and then autumn will return crowned with plenty; and last of all, amidst a thousand varied and most bountiful preparations for the sustenance of animal and vegetable life, during the rigours of an ungenial sky, winter will arrive, and once more prepare the earth, by a night of rest, for the labours of the coming year.

These wonders of Divine providence need only to be mentioned, to show with what consummate skill and goodness God accommodates the seasons to the comfort, the convenience, and the happiness of every thing that lives, and especially of the human family. While the labour to which man is doomed strengthens his bodily powers, and rouses, exercises, and sharpens his mental faculties; the changes, which are continually taking place, are highly conducive to his improvement and happiness. Sameness deadens curiosity, and satiates enjoyment. We are so constituted, as to require constant vicissitudes for stimulating the mind, and giving relish to our exercises; and in each season of the year we find employments suitable to our faculties, and calculated to afford them agreeable and useful occupation. Even in winter, cold and comfortless as it appears, how much do we find to make us both happier and better. The family circle, collected in the long evenings round the cheerful winter fire, feel those affections warmed which soften the heart without enfeebling it, and those domestic endearments increased by exercise, without which life is

scarcely desirable; while the soul, enlightened and enlarged, is better prepared to receive impressions of religion,—to love Him who first loved us,—and, rising to more exalted views, to aspire after the society of the just made perfect, in the world of spirits.

The paternal care of the Supreme Being, thus strongly impressed on the mind, by contemplating the traces of his beneficence, which are every where conspicuous in the seasons as they revolve, are calculated to reassure the mind, in looking forward to that great change, of the approach of which we are forcibly reminded by the passing away of another year, of the short and uncertain period allotted us on earth. We, too, have our spring, our summer, our autumn, and our winter Will another spring dawn on the winter of the grave? To the encouraging answer which Revelation gives to this important question, is added our experience of the operations of the God of the Seasons. Under his administration, nothing perishes, though every thing changes. The flowers die but to live again. In the animal world, many species sleep out the winter, to awake again in a new season. Nature itself expires and revives; even while she lies prostrate and rigid, an Almighty hand preserves the germs of future life, that she may once more start from the grave, and run a new round of beauty, animation, and enjoyment. Is there not hope, then, for the human soul? Shall not the same paternal goodness watch over it in its seeming extinction, and cause it to survive the winter of death? Yes, there is *hope* here, but there is no assurance. It is from the word of inspiration alone that the assurance of immortality springs. That book of unerring truth informs us, that after our mortal winter, there comes a spring of unfading beauty and eternal joy, where no cold chills, and no heat scorches; where there is bloom without decay, and a sky without a cloud.

But let it never be forgotten, that the prospect which lies before us is not all bright and smiling. The same

book of truth which reveals to us our immortal nature, informs us also, that, in the unseen world to which we are travelling, there is a state of misery as well as a state of blessedness;—that we are now, step by step, approaching the one or the other of these states;—and that each successive year, as it passes over our heads, instead of leading us upward to the unchanging glories which belong to the children of God, may be only conducting us downward, on that road which "leadeth to destruction."

This is inexpressibly dreadful! And when we think of our own character and qualifications, we shall find nothing calculated to allay our terrors. We are the children of a fallen parent,—ourselves fallen and guilty. If, from the elevated spot on which we now stand, at the commencement of a new stage of our journey, we look back on the scenes through which we have passed, and reflect on the transactions in which we have been engaged, what shall we discover that can recommend us to Him "who is of purer eyes than to behold iniquity?" If, again, we look forward, what a scene of turmoil and disorder, temptation and danger, do we descry in a world lying in wickedness! When we think of the weakness of our own hearts, and of the enemies we have to encounter—so numerous and so formidable—we cannot fail to be appalled, and to experience the same kind of misgiving which led an apostle to exclaim, "Who is sufficient for these things!"

But when, in the exercise of faith, we turn to the Gospel, a more blessed view opens to us; for it is full of the most encouraging promises to those who will accept of them. It tells us of "the Lord God merciful and gracious, long suffering and slow to anger, abundant in loving kindness and tender mercy;" and, in proof of this character, it reminds us of the impartial manner in which the Creator employs inanimate nature for the good of His creatures, "making His sun to rise on the evil and the good, and sending rain on the just and the

unjust;" it reminds us, also, of the parental affection with which His own exuberant bounty has inspired the animal creation, and, taking an example from the inferior tribes, it beautifully declares, that "as an eagle stirreth up her nest, fluttereth over her young, spreadeth abroad her wings, taketh them, beareth them on her wings," so He watches over His rational offspring, delighting to lead, instruct, and bless them: Rising still higher, it reminds us of the tenderness He has infused into the mind of earthly parents, and says, "if you being evil, know how to give good gifts to your children, how much more shall your Father which is in heaven give good things to those who ask him." Nay, it represents the Eternal as condescending to compare his regard for his people, with that of a fond mother for the infant smiling upon her knee, "Can a mother forget her sucking child, that she should not have compassion on the son of her womb? yea, she may forget; yet will not I forget thee." It does much more; it opens up to us the wonders of redeeming love, presenting to our view the Son of the Eternal humbling Himself for our sakes, to assume the form of a servant,—becoming a man of sorrows,—submitting to ignominy, torture, and death; and then it crowns all, by making this unanswerable appeal, "If God spared not his own Son, but delivered him up for us all, how shall he not, with him, also freely give us all things!"

Such is the unspeakable encouragement which the Christian derives from the Gospel of his Divine Master. And shall we not "work out our own salvation, seeing it is God who worketh in us both to will and to do of his good pleasure." In this mighty task, we cannot indeed avoid being affected with "fear and trembling," when we reflect on what we have at stake; but we have also every thing to hope, for He who is for us, is greater than all that can be against us; and the value of the prize which is set before us is inestimable.

NINTH WEEK—SATURDAY.

MIGRATION OF THE LAND-CRAB.

As I do not intend to resume, in any other part of this work, the subject of migration, I shall now notice one other migratory animal, which deserts its usual haunts for the purpose of finding an appropriate spot for depositing its eggs, and whose instinct, in this respect, is peculiarly remarkable. I allude to the land-crab. It is noticed by Kirby, but I shall chiefly follow the account given in "Goldsmith's Animated Nature," which contains most of the particulars known of this extraordinary little animal, and from which the description of it, both in the work already mentioned, and in the Edinburgh Encyclopedia, seems to be principally drawn.

The crab is of the same kind with the lobster, which in many particulars it resembles. The residence of the greater part of the species is in the waters; but that which I am now about to present to my readers, is entirely an inhabitant of the land, being found chiefly among the mountainous ranges of the Caribbee Islands; and, although it has gills like a fish, it speedily perishes when submerged. There is one occasion, however, and only one, when it seeks the sea-coast, and seems to prove, not only by its form, but by its habits, its affinity to its congeners of the ocean; and that is, when it is about to reproduce its species. It would seem that the eggs of this creature, which bear a remarkable resemblance to the spawn of fish, require to be hatched in the sea. The crab is warned of this by its instinct; and, though its usual residence is in mountainous districts, at a considerable distance from the shore, where it lives on roots and vegetables, and where its habits are exceedingly retired, it undertakes a tedious and perilous journey, in obedience to the first law of its nature. The form of

this animal is little fitted for travelling. It is thus graphically described by Goldsmith :—"The violet-crab somewhat resembles two hands, cut through the middle, and joined together; for each side looks like four fingers, and the two nippers or claws resemble the thumbs. All the rest of the body is covered with a shell as large as a man's hand, and bunched in the middle, on the fore-part of which there are two long eyes, of the size of a grain of barley, as transparent as crystal, and as hard as horn. A little below these, is the mouth, covered with a sort of barbs, under which there are two broad sharp teeth, as white as snow. They are not placed, as in other animals, cross ways, but in an opposite direction, not much unlike the blades of a pair of scissors. With these teeth they can easily cut leaves, fruits, and rotten wood, which is their usual food. But their principal instrument for cutting and seizing their food, is their nippers, which catch such a hold, that the animal loses the limb sooner than its grasp, and is often seen scampering off, having left its claw still holding fast upon its enemy."

Such is the creature whose extraordinary instinct we are about to describe. Among the mountains they live in a kind of orderly community, usually burrowing in the earth, in the midst of inaccessible retreats. They choose the month of April or May to begin their expedition, and then sally out by thousands from the stumps of hollow trees, from the clefts of the rocks, and from the holes which they dig for themselves under the surface of the ground. The procession sets forward with the regularity of a well-disciplined army. They are commonly divided into three battalions, of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route, and face the greatest dangers. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and these descend in regular array, being formed into columns sometimes of fifty paces broad, and three miles deep, and so close that there

is no setting down one's foot, without treading on some of them. Three or four days after this, the rear-guard follows, a straggling undisciplined tribe, consisting of males and females, neither so robust nor so numerous as the former. The sea being the place of their destination, to that they direct their march, with right-lined precision, turning neither to the right hand nor the left, except compelled by absolute necessity, and attempting even to scale the walls of houses which may be in their way, rather than be diverted from their direct course. "At this season," says Mr Barclay, in a paper published in the New Edinburgh Philosophical Journal, speaking of what happens in Jamaica, "it is impossible to keep them out of the houses, or even out of the bed-rooms, where, at one time scratching with their large claws, and at another rattling across the floor, they make a noise that would not a little astonish and alarm a stranger." The night is their chief time of proceeding; but, if it rains by day, they do not fail to profit by the occasion, continuing to move forward in their slow uniform manner. When the sun shines, and is hot on the surface of the ground, they make a universal halt, and wait till the cool of the evening. When terrified, they move back in a confused disorderly manner, holding up their nippers as a weapon of offence, and clattering them together, as if to threaten with vengeance those who disturb them. It is remarkable, that if any of them get maimed on their journey, and unable to proceed, instead of leaving them to fall a prey to their enemies, their companions fall upon them, and tear them to pieces; and, although not naturally carnivorous animals, they are said to devour them on the spot.

After escaping a thousand dangers in the course of a march, which sometimes occupies three months, they at last arrive at the shore, and prepare to cast their spawn. The eggs are as yet within their bodies, and not excluded, as is usual in animals of this kind, into a receptacle under their tail. But no sooner does the crab reach the

shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems to be a necessary preparation for bringing the spawn to maturity; and, without farther delay, it withdraws to seek a lodging on land. The spawn now grows rapidly larger, is excluded from the body, and sticks to the barbs under the flaps of the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this state, the crabs once more seek the shore; and, shaking off the spawn into the water, leave it to be hatched by the united influence of the sea and a tropical sun, and immediately begin their retreat to the mountains, which, however, their exhausted state often prevents them from ever again being able to reach, especially as they are said to moult or cast their shells by the way. It is said that whole shoals of hungry fish are, at this time, watching the shore, in expectation of the annual supply which Providence has thus provided for them. However this may be, millions escape the rapacity of these enemies; and, soon after, an immense tribe of little crabs is seen quitting the shore, and slowly travelling up to the mountains. Mr Barclay, in the paper already alluded to, gives a striking description of a migration of these singular animals, which he himself witnessed in Jamaica, but which he seems to consider as altogether unusual in that island, at least to the extent which he details. "On descending Quahill," says this gentleman, "from the vale of Plaintain-garden River, the road appeared of a reddish colour, as if strewed with brick-dust. I dismounted from my horse to examine the cause of so unusual an appearance, and was not a little astonished to find that it was owing to myriads of young *black* crabs,* about the size of the nail of a man's finger, crossing the road, and moving, at a pretty pace, direct for the mountains. I was concerned to think of the destruction I was causing in travelling through such

* This is the same species as that above described, which is called by Goldsmith the violet crab.

a body of useful creatures, as I fancied that, every time my horse put down a foot, it was the loss of at least ten lives. I rode along the coast, a distance of at least fifteen miles, and found it nearly the same the whole way, only that, in some places, they were more numerous, in others less so. Returning the following day, I found the road still covered with them, the same as the day before."* It is worthy of remark, that this prodigious multitude of young ones, were moving from a rock-bound shore, formed by inaccessible cliffs, the abode of sea-birds, and against which the waves of the sea were constantly dashed by the trade-wind blowing directly upon them. That the old crabs should be able to deposit their eggs in such a part of the coast (if that, as would appear, is the habit of the animal), is not a little extraordinary."

The whole of this well authenticated history is so full of wonder and instruction, that, did space admit, I should be tempted to express the feelings to which it naturally gives rise; but the conclusions which may be drawn from it, in favour of Creative Intelligence, are too obvious to require comment, and may be safely left to the reflections of the reader. The delicate food which is thus thrown, as if by the immediate hand of Providence, in the way both of the inhabitants of the land and sea, will not escape observation.†

* Mr Barclay expresses the utmost surprise at this phenomenon, which he declares to be altogether unprecedented: but if it be true that the young as well as old crabs, usually burrow through the day, and travel only by night, this may partly account for the appearance not being familiar to the inhabitants. On the present occasion, some peculiar state of the atmosphere may perhaps have led the animal to deviate from its usual instinct.

† Mr Barclay says, that he has seen several thousand crabs caught in one night by the Negroes, for sale or home consumption: and he adds, that they are one of the greatest delicacies in the West Indies.

TENTH WEEK—SUNDAY.

WINTER AN EMBLEM OF DEATH.

The seasons of the year have been aptly compared with the various stages in the life of man. Spring, when Nature bursts into new life, and with such grace unfolds its growing charms, amidst alternate smiles and tears, beautifully shadows forth the period of infancy and youth; summer, with its full-blown beauties, and its vigorous powers, represents the maturity of manhood; autumn, when the golden harvests are reaped, and the fields are stripped of their honours, and exhausted Nature begins to droop, is a striking figure of the finished labours, the grey hairs, and the advancing feebleness of old age; while winter, cold, desolate, and lifeless, indicates, with an accuracy not more remarkable than it is affecting, the rigid features and prostrate energies of the human frame in death.

The close of the year which has just taken place, and the gloom which still continues, seem peculiarly calculated to remind us of human decay. The vital powers which produced and sustained vegetation are withdrawn; the forests are leafless; hill and dale mourn their faded verdure; and cheerless desolation reigns. Recollections of the past, and anticipations of the future, oppress the sensitive mind. Let us turn our thoughts, then, on the congenial subject of death: it is the common lot of every thing that lives. From the microscopic insect to man,—all must die. Each has its spring, its summer, and its autumn;—each, also, has its winter. With some, life is literally but a single day,—or less, a few hours perhaps;—others survive even the period of human existence; but the various stages of life belong to the ephemera, as well as to the elephant; and the former fulfils the end of its being, as well as the latter; while the hours of the one are per-

haps equally pregnant with incidents, as the years of the other.

Death is gloomy and revolting, if we look only at its externals. Who, that has seen a lifeless corpse, has been able to remain unmoved, by the affecting contrast to its former self, which it exhibited? The closed and sunken eye, which erewhile beamed with intelligence, or sparkled with delight; the motionless lips, which gave utterance to sentiments of wisdom and of piety, or, it may be, of reckless folly and unblushing falsehood; the heart which beat with feeling, and the head which meditated, planned, and formed conclusions, what are they now? A heap of lifeless clay,—a mass of corruption,—food for worms!

But, when we look deeper, and regard death with the eye of reason and religion, it assumes a very different aspect. The body is but the house of the soul. The feeble tenement has fallen into decay, and its living inmate has removed. It is but the covering in which the chrysalis was confined; the time of its change has arrived, and it has burst its shell, to expatiate in a new life; or rather it is the instrument with which an intelligent being performed its work;—the task is finished—the instrument is worn out, and cast away,—the artificer has gone to other labours.

Such is the conclusion of reason; and the analogy of Nature gives countenance to the view. Nothing is annihilated. Every thing, indeed,—organized matter above all,—grows old, corrupts, and decays; but it does not cease to exist, it only changes its form. The herbs, the flowers, and the leafy pride of spring and summer, wither, fall, and are mingled with their parent earth; but from their mouldering remains, elements are furnished which clothe a new year with vegetable life, as fresh, and abundant, and lovely as before. Nature is not dead, but sleepeth. The seeds, roots, and buds of the year that are past, are preserved, through the rigours of winter, with admirable care, till the voice of a new spring calls them

once more into life, that the seasons may again run their course, and autumn may again spread her liberal feast. Neither does the soul perish. It has "shuffled off its mortal coil," but it has not ceased to live. This is a conclusion at which we eagerly arrive.

What, then, has become of this ethereal spark? Reason cannot tell; but conjecture has been rife. Some have imagined, that the disembodied spirit passes into other bodies, and runs a new course of birth, life, and death, in new forms,—that all living things, from the lowest to the highest grade, are possessed of souls, which either have animated, or may yet animate, human frames; and that a constant change from species to species, and from individual to individual, is taking place, regulated, in some mysterious way, by the law of retribution. This ingenious fancy, which has been called the doctrine of metempsychosis or transmigration, has been widely disseminated through the extensive regions of the East, and has given a very peculiar mould to the practices, and even to the moral character, of those who receive it.

A prouder and more metaphysical philosophy, which prevails in the same quarter of the world, has offered another solution of the question. All life, it is said by the followers of this sect, is but an emanation from the great fountain of existence,—a drop from the universal ocean of life. Death comes, and the emanation is absorbed,—the drop returns to the ocean, and mingles, undistinguished, with its parent element.

Another doctrine, well known, because associated with all our classical recollections, is that of Greece and Rome; which assigns to souls a separate state of existence in the infernal regions, where rewards and punishments are awarded, according to the good or evil deeds of a present life. The puerile fables, false morality, and fanciful traditions, which are mingled with this doctrine, tend to debase and render contemptible, what might otherwise be considered as the germ of a purer faith.

All that history records, or modern discoveries have

ascertained, of the belief of mankind on this subject of vital importance, tends to show the impotence of human reason; and shuts us up to the revealed word of God, as the only source of light and of hope, as regards the future destiny of man. The soul survives the grave, but where does it go? What new forms of being does it assume? What conflicts and what triumphs are reserved for it? These are questions which curiosity, that powerful principle, unites with every selfish and every ennobling feeling of the human heart, to urge on the attention. And what is the answer which the divine oracles return? Man is a sinner, and "the wages of sin is death. Such is the appalling response. And what is death? Not the separation of the soul from the body merely, but the separation of both soul and body from God for ever.

And is there no remedy? Not in the power of man, but in the grace and mercy of God. "God so loved the world, that he sent his only begotten Son, that whosoever believeth on Him might not perish, but have everlasting life." The incarnate Son of the Eternal God is our Saviour. He came to earth, and assumed our form and nature, that He might take away sin by the sacrifice of Himself. His own words are, "I am the resurrection and the life. Whosoever believeth in me, though he were dead, yet shall he live; and whosoever liveth and believeth in me, shall never die."

Blessed assurance! But does it belong to all? Alas, no! It belongs only to believers. All else are excluded. What, then, is the portion of unbelievers? There is only one answer,—"Spiritual death." Their inheritance is, the undying worm, and the unquenchable fire. The offer of life has been freely made, and they have rejected it: It has been urged upon them by every motive; it has been enforced by every sanction, and yet they have rejected it The means of grace, the warnings and lessons of Providence, in the varied occurrences of life, have all been employed in vain. They have chosen death, and have sealed their own doom.

But to you, who close with the offered redemption, it is not less secure, than it is glorious in the means employed, and unspeakably gracious in the blessings bestowed. By the vicarious sufferings of the Son of God, sin is punished, and the sinner absolved; eternal justice is satisfied; and infinite holiness is reconciled. From the horrors of impending destruction, the guilty descendant of Adam is introduced to anticipations of everlasting life; —the child of Satan has become an adopted child of God; —the heir of hell, a joint heir with Christ of the blessedness of heaven.

What, then, is death? It is to the Christian but the passing away of a feverish dream, and an awaking to the glorious realities of an endless and unclouded day. This at least it is, as far as regards his soul. But his body goes down to the grave, and, for all that we can perceive, is finally resolved into its native elements. Yet it is not so. A germ remains. It is like seed buried in winter, by the sower, beneath the sluggish soil, that it may undergo a mysterious change, and rise again to life, in a new season, under a more propitious sky. The spring of an eternal year will come. It will breathe on the dry bones, and they shall live. Then shall the soul be reunited to its material frame, "sown a natural body, but raised a spiritual body;" and this mysterious re-union, which seems essential to the perfect happiness of human beings, will consummate the appointed period, when death, the last enemy, shall be "swallowed up in victory;" when time itself shall perish, along with the revolution of seasons, and when one vast, changeless, incomprehensible eternity, shall embrace all.

TENTH WEEK—MONDAY.

HYBERNATION.—OF QUADRUPEDS—THEIR CLOTHING.

One obvious disadvantage arising from the change of climate from heat to cold, is the effect on the bodily frame, which, at one season, is oppressed with the fervid rays of an almost vertical sun, and, at another, made to shiver under the biting blast of a wintry sky. It was not consistent with Divine Wisdom, that this inconvenience should be altogether compensated for; but the contrivances by which it is alleviated, and rendered tolerable, are truly wonderful. One of the most familiar of these contrivances, is a change from summer to winter clothing.

Man is born naked, but his Creator has endowed him with rational powers, which enable him to procure a dress suited to the various climes in which he is destined to live, and to change it with the changing weather, or his altered residence. The lower animals, not being favoured with this high attribute, have their wants, with respect to clothing, attended to in another way. Those which reside under the burning suns of the tropics, are remarkable for their scanty covering of hair, and the total absence of wool; while animals of the very same species, when resident in colder countries, are found to be clothed with a warmer covering, which becomes still more abundant and woolly as we approach the Polar Regions. The remarkable change, in this respect, which takes place within a very limited distance, and under no very violent change of temperature, may be exemplified by comparing the strong and thin bristles of the Devonshire swine, with the furry coat of those of the Highland breed. As an instance of this beneficent law of Nature, in a more extensive range, we may take the sheep, whose

covering, in the tropical regions, is a scanty coat of hair, which, on the alpine ranges of Spain, becomes a fine soft and silky wool; in the mainland of Britain, is changed into a fleece, coarser, indeed, but thicker, and better adapted to resist the vicissitudes of our changeable weather; in the Shetland Islands, undergoes another transformation, still more capable of resisting the cold; and, in Iceland, and other regions verging toward the Pole, acquires the character of a thick fur, interspersed with long and coarse hair,—a provision which is common to the clothing of numerous northern tribes, and which seems admirably calculated at once to foster the animal heat, to give free passage to the insensible perspiration, and to serve as a protection from the penetrating rains.*

Now, what we wish the reader particularly to remark is, that effects similar to those which are produced on the clothing of animals by a change of climate, are, to a certain extent, produced also by the different seasons of the year. There is a beneficent adaptation, in this respect, to the alternations of heat and cold, in the same country. Examples of this wise provision, among our domestic animals, are familiar to every farmer. The horse, the cow, and the sheep, when exposed to the open air, all acquire a rough coat in winter, which they throw off as the warm weather advances, being then supplied with a thinner and sleeker covering; and, what is remarkable, the shagginess, and consequent heat, of their clothing is proportioned, in each species, to the extent of their exposure, and the intensity of the cold. So much is this the case, that it has been alleged, probably, however, with some degree of exaggeration, that, "if we were to look at the horses, for example, of the farmers on a market-day in winter, we might determine the relative temperature of their respective farms, from the relative quantity of clothing provided by Nature for the animals

* See Kirby's Bridgewater Treatise, vol. i. p. 64. See also Scripture Geology, p. 349.

which live on them."* The dealers in fur are well acquainted with the change we are now considering. In summer, the fur of those animals which are valued for the possession of this article of commerce, is too thin and short to be an object of pursuit; but, as soon as the frost and snow begin to show themselves, a rapid alteration takes place, and the fur is then said to have suddenly *ripened*. This is remarkably the case in the hare and rabbit.

Another beneficent provision of the Creator, for alleviating the effects of cold in winter, is to be discovered in the change of colour, which takes place in the clothing of some species, both of quadrupeds and birds. It is remarkable, that the tendency of this change is from dark to pure white. Thus the ermine, which is so much prized for the snow-like whiteness of its fur in winter, is, in other seasons of the year, of a pale brown colour, inclining to red; and the Alpine hare of the Grampian range undergoes a similar change, throwing off its summer dress of tawny grey, and appearing in a coat of the colour of milk. Among the feathered tribes, we find the ptarmigan, which takes up its habitation on the summits of our most lofty Highland mountains, and the guillemot, which frequents our coasts, endowed with an analogous property. In the former, the change is complete; in the case of the latter, its summer covering of black, is, in this climate, converted into a plumage clouded with ash-coloured spots, on a white ground; but, what distinctly marks the intention of the Creator, is, that this latter bird, when exposed, as in Greenland, to a more intense cold, throws off its spotted mantle, and appears in feathers of a beautiful and uniform white.

The object of this remarkable change in the appearance of these animals, is not merely, as some writers have supposed, to protect them from the prying eyes of their enemies, by assimilating their colour to that of the surface of the ground, though this intention is not to be

* Edinburgh Encyclopedia—article Hybernation.

overlooked; but chiefly, as I believe, to provide more effectually for their protection from the alteration in the temperature of the seasons. It might, perhaps, on a superficial view, appear, that white, which consists in the reflection of all the rays of light, was less favourable than any other colour to the heat of the body, and that, were the intention to protect the animals from cold, the process would just be reversed. It is true, indeed, that a dark surface imbibes the heat to which it is exposed in greater quantities than that which is of a light hue, and if this were all that was required, the objection might be held to be well founded. But it must be remembered, that the temperature of a living body depends chiefly on the power of retaining the animal heat; and it is on this principle that we are to look for the ultimate design in the change of colour to which we have alluded. It would appear, from chemical experiment, that the radiating power of bodies is inversely as their reflecting power; and, upon this principle, the white colour of animals, possessing less radiating power than any other, must be best calculated to retain the heat generated in their bodies by the vital principle. Thus, while there is less warmth absorbed from the external atmosphere than if their darker colour had remained, this disadvantage is far more than compensated by the power which their white clothing confers, of resisting the effects of the external cold in reducing the temperature. This is one of the cases which we so commonly meet with in investigations of a similar kind, where an imperfect knowledge of the laws of nature affords room for plausible objections against the arrangements of Providence, which a more profound acquaintance with these laws entirely overturns, and even converts into an argument on the opposite side. Had we only known, that a white colour rejects the influence of external heat more obstinately than all the other colours, we might well be puzzled to account for the fact, that during the winter months a change should take place,

which was to render the bodies of the animals subject to it, less susceptible of atmospherical warmth, in proportion as they seemed most to require this blessing; but, when the more recent discoveries, which prove that the principle of radiation follows an opposite law, set the matter in its true light, it is impossible not to feel that peculiar satisfaction which arises from perceiving the consistency of benevolent design; and the lesson which we are thus taught goes even further, leading us, as it does, confidently to conclude, that wherever facts apparently contradictory of Divine wisdom or goodness are to be found, the difficulty lies, not in the nature of the thing, but in the darkness of human ignorance.

TENTH WEEK—TUESDAY.

HYBERNATION.—STORING INSTINCTS.

As birds have the power, and are endowed, when necessary, with the instinct of migration, they scarcely stand in need of any other means of avoiding the inconveniences of winter; and, accordingly, we find, that except the change already mentioned, of a summer for a winter dress, which takes place in some species, and the autumnal repairing of their feathers, there is no other provision of great importance and extent made for their hybernation. But with quadrupeds, reptiles, and insects, the case is different. As they were destined to be confined to a limited locality, it was necessary to make sufficient arrangements for their accommodation within their native haunts. The warm clothing, which, as we have seen, quadrupeds acquire, is calculated to preserve them from the effects of cold; but something more is necessary. Not only is the breath of winter chilling, but its hand is niggardly of food; and there is danger of starvation, not less from the cravings of hunger than

from the rigour of the weather. To this want the beneficent Creator has not been inattentive; and the means he employs to remedy the evil are not less remarkable than they are efficacious.

There are two ways in which a deficiency in the supply of the necessaries of life may be compensated for, namely, either by the accumulation of a store of provisions during the period of plenty, or by placing the body in such a state as to supersede the use of such accumulation, by rendering it insensible to the demands of hunger, and yet preserving its vital existence. The Creator employs both of these means. This paper shall be devoted to the consideration of the former.

The class of quadrupeds, among which various species are to be found, that lay up a winter store, is exclusively what is known to naturalists by the appellation of *glires*, or gnawing animals. Of this class are the mouse, the squirrel, and the beaver. Of the first species, the field-mouse is the most remarkable for this propensity. This little animal is exceedingly active about the end of autumn in preserving fallen acorns, by burying them under ground; being thus made subservient to the double purpose of hoarding a store for future use, and of planting such part of the seed as it either forgets or does not require, in such a manner that it may germinate and spring up into a future tree,* destined to provide the means of subsistence to distant generations of the species. Such is the wonderful economy of Providence; and this, let it be remarked, in passing, is only one instance of a kind of contrivance extensively employed, which we shall afterward have occasion to notice.

We have mentioned the common squirrel as another example of the storing tribe. This agile and interesting creature takes up its residence in our woods and forests,

* "In the time of acorns falling," says Derham, "I have, by means of the hogs, discovered that the mice had, all over the neighbouring fields, treasured up single acorns in little holes they had scratched, and in which they had carefully covered up the acorn. These the hogs would, day after day, hunt out by the smell."—*Derham's Physico-Theology.*

and, during the last month of autumn, is exceedingly industrious in collecting for itself a hoard of nuts, acorns, and other kinds of food, which it carefully deposits in a storehouse, scooped out with some labour, in a well-chosen place of concealment, among the large and embowering branches of a shaggy old tree. Here it takes up its winter abode, prudently abstaining from the violation of its little magazine, as long as it can find the means of subsistence in its neighbourhood.

But of all the quadrupeds which provide for their preservation during winter, by laying up a stock of food, there are none so wonderful as the beavers. A branch of this amphibious family was at one time to be found in Britain ; and beavers are still natives of some northern countries in Europe, though their chief residence is in the wilds of America. They have long attracted the admiration of mankind by their extraordinary habits. Some of our most celebrated naturalists, indeed, fired by the exaggerated accounts of travellers, have launched out into encomiums on their wonderful faculties, which a more accurate knowledge of their operations has of late considerably modified. After every allowance, however, for the natural propensity of men to add astonishment to the wonderful, we find enough in the most sober and authentic accounts given of this quadruped, to excite our surprise.

The form of the beaver does not appear to be peculiarly well fitted for performing works of skill and labour. It is described as not exceeding three feet in length ; its paws are said to be about the size of a crown piece ; and its tail, though, by its breadth and flatness, answering some important purposes, seems to be limited in power as an instrument of labour, by having naturally such an inclination downward, that it can with difficulty be brought on a line with its back. Yet this apparently weak and ill-furnished creature, is represented as supplying, by its ingenuity, the seeming defects in its bodily form, and constructing works for the comfort and

convenience of its winter residence, which, in reference to its more contracted wants, rival the skill and science of a human architect! The following notice of the manner in which these animals provide against the inclemency of the winter season, is abridged from a judicious article in the Edinburgh Encyclopedia.

"Toward autumn, they quit their roving way of life, form themselves into communities, and, instructed by that admirable instinct of which we have so many examples in the history of the animal creation, begin to provide for the wants of a season, whose duration and inclemency would effectually preclude a regular supply of their accustomed nourishment.

"The winter quarters of the beavers are situated on the banks of a river or a creek, or, where these are not to be found, on the edge of a lake or pond. In selecting the exact spot where they may form their houses, they appear to be guided by two considerations, viz.—a sufficient depth of water, to prevent its being completely frozen; and the existence of a current, by means of which they can readily convey wood and bark to their habitations. To prevent the water from being drained off, when the frost has stopped the current toward its source, the beavers construct a dam across the stream; and, in this work, they certainly display wonderful sagacity, skill, and perseverance. The dam is constructed of drift-wood, branches of willows, birch, poplar, stones, and mud, brought by the beavers in their mouths, or between their paws, and not, as many have asserted, on their tails. If the current be slow, the dam runs straight across; but if the stream be rapid, the dam is formed with a regular curve, having the convexity toward the current, so as effectually to resist the force of the water and ice, that rush down during the storms of winter, or the thaws that take place in spring. These dams are several feet in thickness, and of such strength, when completely formed, that a man can walk along them with perfect safety.

"Having completed their dam, they proceed to construct their cabins. These are partly excavations in the ground, though their roofs form a sort of vaulted dome that rises a little above the surface. The houses have seldom more than one apartment, and never more than one floor, which is raised in the middle, to allow of the inhabitants eating and sleeping in a dry situation. The principal entrance and outlet to these houses, is next the water, on the very edge of which they are constructed; and the opening always slopes toward the water, till it terminates so far below its surface, as to preserve a free communication in the most severe frosts. There appears to be another, though smaller, opening next the land. The houses are of various sizes, in proportion to the number of inhabitants, which seldom exceeds ten or twelve, though sometimes double that number has been found in the same dwelling. Many of these houses stand together along the margin of the water, forming a village of from ten to thirty tenements.

"During the latter end of summer, the beavers cut down their wood, and collect their roots. The latter are kept in the water, whence they fetch them as occasion may require. In eating, they sit on their rump like a squirrel, with their tail doubled in between their hind legs, and holding their food between their paws. When disturbed, they utter a peculiar cry, and plunge into the water, flapping the ground and the water with their tail."

The faculty of storing is also to be found, as we have previously stated, among insects, of which the example of the honey-bee is the most striking. The habits of this wonderful insect, the large and orderly community in which it lives, yielding undeviating fealty to a female sovereign; the mathematical precision with which it builds its cell; its unwearying industry; its wise foresight; its colonizing propensity, have already been described in speaking of the hybernating instincts of the insect creation. In studying its operations, as well as

that of the beaver, and indeed of the other storing animals, we seem to get still deeper insight into the nature of that mysterious faculty which, resembling reason in so many particulars, yet differs from it in this, that its impulses are uniform and unchangeable, belonging nearly in equal perfection in all ages, and under all circumstances, to every individual of the species; not capable of improvement by education, but regulated by propensities which are directed by a wisdom of which the species is not conscious, to the attainment of a future object, which they have not forethought to contemplate.* What is this but the impress of the finger of God?

* Mr Broderip gives a curious and interesting account of the habits of a tame beaver, brought to this country in 1825, which seems to illustrate the distinctive difference subsisting between reason and instinct, even where they appear to make the nearest approach. This little creature was still very young when let out of his cage, but immediately showed his building instinct. He began by selecting the longest materials within his reach, such as sticks, sweeping-brushes, &c., which he piled up in such a way that one end touched the wall, and the other projected into the room. "As the work grew high, he supported himself upon his tail, which propped him up admirably; and he would often, after laying on one of his building materials, sit up over against it, apparently to consider his work, or, as the country people say, 'judge it.' This pause was sometimes followed by changing the position of the material 'judged,' and sometimes it was left in its place. After he had piled up his materials in one part of the room (for he generally chose the same place), he proceeded to wall up the space between the feet of a chest of drawers which stood at a little distance from it, high enough on its legs to make the bottom a roof for him, using, for this purpose, dried turf and sticks, which he laid very even, and filling up the interstices with bits of coal, hay, cloth, or any thing he could pick up. This last place he seemed to appropriate for his dwelling; the former work seemed to be intended for a *dam*. When he had walled up the space between the feet of a chest of drawers, he proceeded to carry in sticks, cloth, hay, cotton, and to make a nest; and, when he had done, he would sit up under the drawers, and comb himself with the nails of his hind feet."

It is scarcely necessary to say, that there was, in the case of this tame beaver, a propensity evinced to construct, where the object of the propensity no longer existed. The Author of its being had bestowed on it this instinct, for the use of the species in its wild state; and, being destitute of the reasoning power which would have taught it the needlessness of the trouble it was taking, it still continued not only to build its house, and line its nest, where it was already sheltered and comfortable, but to construct a dam where there was no water.

TENTH WEEK—WEDNESDAY.

HYBERNATION.—TORPIDITY OF ANIMALS.

Among the contrivances by which the Author of Nature enables the lower animals to sustain the privations of winter, that by which they are endowed with the faculty of becoming insensible to external objects, and of approaching a state of temporary death, is very worthy of attention. The ordinary phenomena of sleep have long been a subject of deep curiosity to the philosophical inquirer. The torpidity of animals during the cold season, in some respects, resembles this state; but there is a marked difference not only in the period of insensibility, and in the wise intentions of Providence which it fulfils, but also in the nature of this provision, as it affects the bodily frame, as well as in other particulars.

The subject of torpidity has given rise to several ingenious experiments, by which some curious facts have been elicited. It is not our object to record these, but merely to give a succinct view of their results, in so far as they throw light on the operations of that Divine Being, from whose wisdom and goodness they derive their origin.

The classes of animals, among whom this kind of hybernating principle is found, are very various, viz. quadrupeds, reptiles, insects, perhaps fishes, and, according to some, even birds. Among quadrupeds, the species which are known to become torpid, belong exclusively to the digitated order. A few of these species are of the class *primates*, such as the bat; and of the class *feræ*, such as the hedgehog; but the most numerous instances occur among the *glires*, of which the dormouse and the marmot are familiar examples.

Attempts have been made, but without much success, to ascertain the causes on which torpidity depends. It

is not extreme cold, as many have maintained, for some animals collect in deep caves, where the temperature is never low, or congregate and burrow in the earth, where the heat of their bodies preserves a temperature not much inferior to that of the average state of the external atmosphere; and others become lethargic even in warm climates. It is not the position which the body assumes, when about to become torpid, though this has also been alleged; for the different species seem to assume no other position than that to which they are accustomed in ordinary rest; it is not, so far as has been ascertained, any distinct and uniform state of the anatomical conformation, for anatomists have, in vain, attempted to establish any peculiarity in the bodily structure of such animals, which can account for the phenomenon; it is not, in fine, an immediate destitution of food, for a remarkable fact connected with this state is, that when animals become torpid, they are, generally speaking, unusually plump and fat. Some of these circumstances, indeed, commonly occur at the period when these animals fall into the dormant state, and seem, in a certain degree, to influence the result. Thus, the exact time of the change may be hastened or retarded, by the temperature of the atmosphere, or the plenty or scarcity of food; but there seems to be no reason to conclude, that these circumstances, considered merely as physical causes, are sufficient to account for the phenomenon; and we are rather inclined to believe, that the animals themselves have some power in their own volition, of either inducing or resisting the lethargic condition. Spalanzani has seen bats in a torpid state, even during summer. A migratory hamster *(cricetus glis)*, was placed by Mangili in a state of confinement, in spring, when it was naturally in its waking period; and, as soon as it found that it could not escape, it refused to eat, and, throwing itself on its back, became torpid, in which state it remained till the 17th July. The land-testacea certainly have the power of becoming torpid, independent

of the severity of the weather. If specimens of the *helix hortensis*, for example, be placed, even at midsummer, in a box without food, they soon attach themselves to the side of the place of their confinement, and become dormant; in which state they may be kept for several years.

Torpidity, in short, is an instinct, and exhibits many of the interesting but mysterious characteristics of this faculty. When the season of storms and scarcity is about to arrive, the animals to whom this habit belongs, carefully select a proper place of retreat, respectively corresponding to their several natures, where they may spend, in a happy oblivion, the dreary winter months. "The bat," to borrow the words of the article "Hybernation," in the Edinburgh Encyclopedia, "retires to the roof of gloomy caves, or to the old chimneys of uninhabited castles; the hedgehog wraps itself up in those leaves of which it composes its nest, and remains at the bottom of the hedge, or under covert of the furze which screened it during summer, from the scorching sun or the passing storm; the marmot and the hamster retire to their subterranean retreats, and when they feel the first approach of the torpid state, shut the passages to their habitations in such a manner, that it is more easy to dig up the earth any where else, than in the parts which they have thus fortified." "Many of those animals, particularly such as belong to the great natural family of *gnawers*, make provision in their retreats during the harvest month. The marmot, it is true, lays up no stock of provisions; but the hamsters fill their stores with all kinds of grain, on which they are supposed to feed until the cold becomes sufficiently intense to induce torpidity. The *cricetus glis*, or migratory hamster of Pallas, also lays up a stock of provisions. The same remark is equally applicable to the dormouse."

Animals, in preparing for this dormant state, are considerably actuated by their usual habits while awake, not only in the choice of a place of retreat, but also with

regard to their social or solitary habits. Thus, the hedgehog and dormouse spend their period of insensibility alone, while the marmot, the hamster, and the bat, collect, for this purpose, in large societies.

Some curious particulars have been noted of the physical condition of animals during their torpidity, which it seems unnecessary to do more than barely to enumerate. In this state they suffer a great diminution of temperature; they breathe slowly, and only at intervals proportioned to the depth of their slumber, sometimes with long periods of total intermission; the circulation of their blood becomes languid to such an extent, that even the pulsation of the heart is scarcely felt; the animal irritability decreases, so that limbs may be lopped off, and even the vital parts laid open, almost without exciting any symptoms of feeling; the action of the digestive organs is suspended; the body becomes gradually emaciated, and its weight is diminished, but without impairing the living principle, which, on the contrary, is found to be in a remarkably energetic and active state at the period of resuscitation.

Many of the observations which we have made as to quadrupeds, will apply also to reptiles. These cold-blooded animals adopt similar precautions in selecting proper places of retreat, to protect them from their enemies, and to preserve them from sudden alternations of temperature. Those, which inhabit the waters, sink into the soft mud; while such as live on land, enter the holes and crevices of rocks, or other places, where there is little change of temperature. Thus disposed of, they obey the impulse, and become torpid. The effect of cold in inducing and prolonging this state, is much more remarkable than in warm-blooded animals. It is said that frogs and snakes may be kept in a torpid state, in an ice-house, for several years, without any diminution of their vital energy. It is, perhaps, on a similar principle, that toads have been found alive, after having, for centuries, been embedded in the heart of stones.

The torpidity of the *mollusca* tribes, and of insects, is much more general than that of the higher genera of animals; but as the state of these more minute animals during winter has occupied our attention in other papers, I shall at present pass the subject with this single observation, that the paternal care of the Creator is not less conspicuous in the case of the microscopic insect, than that of the most lordly quadruped; and that the lower down we go in the scale of existence, the more striking appear to be the proofs of a universal Providence, which has caused the world to teem with life and enjoyment.

If we cannot, from physical causes, account for the torpidity of animals, neither shall we be able to discover, in such causes, any adequate reason for their revival at the fit period. This revival does not take place in all classes at the same time; but, speaking generally, none of them burst their lethargic chains till the revolving season has brought round a genial warmth, along with supplies of proper nourishment. Had we only to account for the revivescence of those animals which are exposed to the changes of temperature, we might, perhaps, rest satisfied with the idea, that the return of warmth was the immediate stimulus by which the change was effected; but what shall we say of the numerous instances in which these sleepers of winter bury themselves so deep, or lie congregated so close, and secured so carefully, as to remain beyond the reach of atmospheric changes? By what calendar do the bats, for example, in the interminable windings and dark recesses of the Mammoth cave of Kentucky, count the return of the months of spring? What voice whispers to the little marmot, as it lies in its deep burrow, fostered by the animal heat of its fellows, with every avenue to the open air effectually sealed up, that the stiffening frost no longer enchains the soil, and that the season of herbs and of roots has returned? Only one answer can be returned; and we are forced anew to acknowledge

the presence of a mysterious instinct, or rather of that bountiful Being who, while He every where works, every where conceals Himself from mortal eyes; or is seen only by reflection from his visible creation.

We mean not to assert, either here or elsewhere, that, in the processes of instinct, the Creator does not act, as he acts in the more known operations of nature, by means of second causes, which might be made manifest to rational creatures, and the force and adequacy of which might be understood by them; but we do mean to say, that these causes have not yet been discovered; and that, whether discovered or not, there is, in the appearances we have been considering, a distinct and undeniable indication of a Supreme Intelligence moulding the faculties of living creatures, and wonderfully adapting their powers to the circumstances of the external creation, so as to promote the preservation of their existence, and to contribute to their enjoyment.

TENTH WEEK—THURSDAY.

I. MAN IN WINTER.—PRIVATION STIMULATES HIS FACULTIES.

There is something very peculiar, but remarkably adapted to the general constitution of nature, in the circumstances and condition of man, as compared with other animals, pointing directly to certain great ends and principles of his existence, and confirming, in a very striking manner, the character which we have already stated to be impressed by the great Creator on his works. Man is, of all animals, the least provided with natural means of defence from his numerous enemies, as far as relates to his bodily powers, and the most scantily supplied with protection from the vicissitudes of climate. He enters life unclothed, and utterly helpless; he grows up slowly to manhood, amidst a thousand difficulties

and dangers. During the first period of his existence, he must necessarily depend on the good offices of others for the means of preserving life; and in the last stage he descends again into all the feebleness, inactivity, and dependance, of a second childhood. It is not so with other animals. They come into the world clothed, armed, and furnished with instruments and means of subsistence, or, at least, after a few days or weeks of dependance on their parents, they are thrown upon their own resources, with ample means of support and enjoyment. This contrast between the early condition of man and the lower animals, is described by a Roman poet with much truth and beauty :—

"Tum porro puer, ut sævis projectus ab undis
Navita, nudus humi jacet, infans, indigus omni
Vitali auxilio, cum primum in luminis oras
Nixibus, ex alvo matris natura profudit;
Vagituque locum lugubri complet, ut æquum est,
Cui tantum in vita restet transire malorum.
At variæ crescunt Pecudes, Armenta, Feræque;
Nec crepitacula eis opu' sunt, nec cuiquam adhibenda est
Almæ nutricis blanda atque infracta loquela:
Nec varias quærunt vesteis, pro tempore cœli.
Denique non armis opus est, non mœnibus altis,
Queis sua tutentur, quando omnibus omnia large
Tellus ipsa parit, naturaque dædala rerum."

The intention of the Creator in thus throwing the infant on the immediate protection and tender assiduities of his parents, is not unkind, but the very reverse. Constituted as man is, such a state of dependance on the one hand, and of guardianship on the other, is of the highest importance to the development of the moral and even of the intellectual faculties, and impresses a character of affection and of mutual sympathy on the human heart, which extends from the family circle to the whole relations of life; and, while it binds society together by the strongest ties, sheds over it the most endearing charm.

But it is not in this view that we are led at present to consider the subject. We have to inquire how this naked and houseless creature finds shelter and protection from the rigours of winter; and this throws us into a wide but most interesting field of inquiry, leading, as it does, to a consideration of the peculiar provisions and adaptations by which the energies of the human mind are called forth and disciplined,—a subject to which we formerly adverted, but which seems worthy of reconsideration, as applicable to this particular case.

The sentence which has passed on fallen man is, "In the sweat of thy face shalt thou eat bread, till thou return under the ground;" and, by the peculiar ordinance of a wonder-working Providence, that which is his curse is converted into the means of giving vigour and enlargement to his mental powers. It is by the pressure of necessity, and the urgency of want, that our natural aversion from labour and love of inaction are overcome. To prove this, we do not need to revert to the theories of philosophers, or to follow man through his fancied stages of advancement, from his lowest grade,—a savage roamer of the forest, feeding on nuts and roots,—till we find him, first a hunter and fisher, then a shepherd, next a tiller of the soil, and, last of all, a man of commerce, and an adept in the arts and sciences.

In the supposed steps of this progress, history does not bear us out; but we do know, from all history, as well as from daily experience, that the wants of man stimulate his ingenuity; that these wants increase with the power of gratifying them, while the ingenuity which supplies them keeps pace with his enlarging desires, and that thus there is a constant action and re-action, which, by a most wonderful and interesting process, urges man on from stage to stage of improvement, till he becomes, what we find him to be in the most advanced state of society,—a being as different, in his mental attainments, from the wandering savage, as the lordly elephant, in his bodily powers, is from the blind worm of the earth.

The human mind is mighty and various in its powers; but before these powers become available to any great extent, they must be excited by external objects, and trained and moulded by discipline, and enlightened by the accumulated wisdom of ages; and for the performance of these important functions, the circumstances and condition of external nature are admirably suited.

This observation applies universally, and might be illustrated in a thousand different ways; but take the case immediately before us,—the necessity of protection from the vicissitudes of the seasons. In what state do we find civilized man? Think of the comforts and conveniences which he has accumulated around him, for the purpose in view. This naturally naked and helpless creature, makes the whole creation, both animate and inanimate, tributary to his defence from the wintry blast, and from the summer's heat. The hemp, the flax, the cotton plant, and the inner bark of various trees, yield their vegetable stores; the sheep gives its fleece; the silkworm its web; the cow her hide; the goose and the eider-duck their down; the beaver, the ermine, and the bear, their fur, that his want of natural clothing may be supplied; and that, by adapting his covering to the peculiarity of the climate, he may either brave the rigours of a polar sky, or support, without material inconvenience, the fierce rays of a tropical sun.

Again, attend to his place of residence.—What conveniences!—what comforts!—what luxuries! Within his own limited locality, Providence has given him every thing necessary for the supply of his wants. Every where there is to be found stone, and lime, and wood, and iron, or some useful substitutes. Of these, the cottage, the hall, and the palace, are all equally constructed. There is, elaborated by his industry, from materials readily within his reach, glass, to admit the light and exclude the chilly blast; there are coals, or billets, or peat, for fire to warm; there are downy beds for neces-

sary rest; and, if ambition or voluptuousness looks farther, the East brings its perfumes and its gems; the West and the South their precious metals and their ornamental furniture; the North its oil, to supply artificial day; all climates and all countries contribute, of their abundance and their varieties, to supply the cravings of a constantly increasing and never satisfied appetite for accumulation and enjoyment.

And so it is, that the very privations and disadvantages, with which man comes into the world, become the means by which the desire of acquiring and improving is stimulated, till he not only equals the lower animals in those gifts, naturally withheld from him, with which Providence had endowed them, but rises far beyond them; and, by means of his mental qualities, deservedly earns for himself the title, which his bodily faculties could never have merited, of being emphatically lord of this nether sphere.

TENTH WEEK—FRIDAY.

II. MAN IN WINTER.—PROVISIONS FOR HIS COMFORT.

It is most interesting to look into the various features of that providential administration, by which, under a very peculiar and surprising discipline, the progress of society is advanced, and man rises in the scale of moral and intelligent beings. In the wants of his natural state, as regards the season of winter, we yesterday saw how a stimulus is employed, which, combined, doubtless, with other incentives, induces him to seek, first, necessaries, then conveniences, then comforts and luxuries, till he draws around him the resources of the world, and, by the ever-expanding views of an aspiring mind, calls progressively into action those mental powers and facul-

ties, both in himself and his fellows, which might otherwise have lain dormant.

If, from this view of the exercise given to genius and talent, in counteracting the privations of winter, we turn to the provisions which have been bountifully made, in external nature, for affording scope to these faculties, we shall find additional cause of devout admiration.

The first thing worthy of remark, in this department of the subject, is, that, speaking generally, the materials by which exposure to the inclemency of the season may be obviated, lie patent and abundant in those climates where such inconveniences are liable to be felt. In proportion as we penetrate into the colder regions, animals are found in greater plenty, whose coats of soft and downy fur, furnished beneficently by their Creator for their own protection, when transferred to the human body, defy the wintry storms. If we approach still nearer the polar circle, we discover a provision which renders even these regions of gloom and intense cold, habitable during the severest part of the year. The enormous tenants of the icy seas, which surround these inhospitable coasts, not only furnish the inhabitants with food; but, being enveloped in immense loads of fat, yield to them all that is needful, both for light and heat, in their dark and chilly winter months. Nay, the very snow, which clothes Nature as in a winding-sheet, and seems to augur nothing but desolation and death, is converted, by the ingenuity of man, into a comfortable habitation, and thus becomes a preserver of life, and a means of enjoyment.

Then, again, if we speak of fuel, how bountiful is Providence in supplying those exhaustless forests of pine in the northern regions of Europe, and those immense fields of coal in Britain, and other similar climates, by which frost is charmed away from the dwellings of the inhabitants! Can we believe it to be without a beneficent design, that such amazing magazines of combustible matter should be deposited within our temperate zones?

And does it not add to the wonder of this provision, that coal is known to be a vegetable production of a climate altogether different from that in which it is found,—a climate probably not inferior in warmth, and in the power of nourishing vegetation, to the most favoured of our tropical regions? When, and under what circumstances, did that profusion of gigantic trees and plants cover the face of the earth, and luxuriate in the sunshine and the shower of a blessed climate, which, under the name of Surturbrand, has erected the platform on which northern Iceland rears its burning mountain, and spreads its rugged hills and plains; and in Britain, the land of manufactures, and America, that new country, buoyant with youthful enterprise, has laid up those amazing stores of fuel, which many centuries of human toil and industry can scarcely be said to diminish? A mystery hangs over the subject, which the geologist, with all his zeal and acuteness, shall probably in vain attempt to penetrate; but it is enough for our present purpose to know the fact. By whatever natural catastrophe these ancient woods and forests were submerged, there they are, collected in the most convenient localities, at once for furnishing the means of comfort during the rigours of an ungenial winter, and for affording facilities to the increase of human power, in the cultivation and improvement of the arts of life.* Is it too much to say, that here is the hand of a Paternal Providence?

* Dr Buckland, after stating that iron is frequently associated with coal in the subordinate beds of the transition series, concludes a chapter on this subject, with the following interesting observations:—"The important uses of coal and iron in administering to the supply of our daily wants, give to every individual amongst us, in almost every moment of our lives, a personal concern, of which but few are conscious, in the geological events of these very distant eras. We are all brought into immediate connexion with the vegetation which clothed the ancient earth, before one-half of its actual surface had yet been formed. The trees of the primeval forests have not, like modern trees, undergone decay, yielding back their elements to the soil and atmosphere, by which they have been nourished, but, treasured up in subterranean storehouses, have been transformed into enduring beds of coal, which, in these later ages, have become to man the sources of heat, and light, and wealth. My fire now burns with fuel, and my lamp is shining with the light of gas, derived from coal that has been buried for countless

Fuel implies the use of fire, and this leads us to look at some of the properties of that wonderful element, which, on the hearth and in the lamp, contributes so materially to the comforts of winter. This is the very same element, which, by its subtle and all-pervading powers, gives light and warmth to the world, and the effects of which, the poet of the Seasons so beautifully describes, in speaking of the adorable power and goodness of the Creator, when he says, that His mighty hand

" Works in the secret deep; shoots, steaming, thence
The fair profusion that o'erspreads the spring,
Flings from the sun direct the flaming day;
Feeds every creature; hurls the tempest forth;
And, as on earth the grateful change revolves,
With transport touches all the springs of life."

In the treatise on Heat, published in the "Library of Useful Knowledge," there are the following introductory observations, which describe, in a popular manner, some of the most obvious effects of this remarkable agent:—"In all our excursions over the surface of the globe, innumerable objects excite our admiration, and contribute to our delight. But whether our gratitude is awakened by the verdure of the earth, the lustre of the waters, or the freshness of the air, it is to the beneficial agency of heat (under Providence), that we are indebted for them

ages in the deep and dark recesses of the earth. We prepare our food, and maintain our forges and furnaces, and the power of our steam-engines with the remains of plants of ancient forms and extinct species, which were swept from the earth ere the formation of the transition strata was completed. Our instruments of cutlery, the tools of our mechanics, and the countless machines which we construct, by the infinitely varied applications of iron, are derived from ore, for the most part coeval with, or more ancient than the fuel, by the aid of which we reduce it to its metallic state, and apply it to innumerable uses in the economy of human life. Thus from the wreck of forests which waved upon the surface of the primeval lands, and from ferruginous mud that was lodged at the bottom of the primeval waters, we derive our chief supplies of coal and iron, those two fundamental elements of art and industry which contribute, more than any other mineral production of the earth, to increase the riches, and multiply the comforts, and ameliorate the condition of mankind."—*Buckland's B T.* vol. i. pp. 66, 67.

all. Without the presence and effects of heat, the earth would be an impenetrable rock, incapable of supporting animal or vegetable life; the waters would be for ever deprived of their fluidity and motion, and the air of its elasticity and its utility together.

"Heat animates, invigorates, and beautifies all Nature. Its influence is absolutely necessary, to enable plants to grow, put forth their flowers, and perfect their fruits. It is closely connected with the powers of life, since animated beings lose their vitality when heat is withdrawn. Such is the universal influence of this powerful agent in the kingdoms of Nature; nor is this influence diminished in the provinces of art. It is with the aid of heat that rocks are rent, and the hidden treasures of the earth obtained. Matter is modified ten thousand ways by its agency, and rendered subservient to the uses of man, furnishing him with useful and appropriate instruments, warm and ornamental clothing, wholesome and delicious food, needful and effectual shelter."

Heat is the principle of *fire*, under whatever modification it may appear; and nothing can be more worthy of admiration, than the fact, that an element of such tremendous power, whose operations are on so vast a scale, and whose mastery is so fearful, should yet be capable of being subjected to the service of man, in the most menial offices, and, in that capacity, should become so mild and tractable. What human mind, in the wildest flights of its fancy, could, previous to experience, have conceived the existence of an agent, which appals nature with its angry roar, and, rending the clouds, darts its livid bolts from heaven to earth, or uprears mountains in its throes, and, opening the solid crust of the globe, overwhelms whole regions with torrents of melted rock, poured forth like water; or, more amazing still, which displays its might and glory, in shedding the effulgence of day over the smiling earth, and regulating the changes of the seasons, and calling the wonders of vegetation from the solid land, while it causes the liquid seas to

flow,—which performs all these wonders, and a thousand more, and yet is so entirely under the control of man, and so subservient to his use, that it remains meekly glimmering amidst smouldering ashes in the grate, ready at his command, to cheer and enlighten his winter evenings, by blazing from a taper, or to employ its obsequious powers, for whatever purpose of culinary preparation, or of genial warmth, his necessities or enjoyments may require. What amazing power and wisdom is here, tempered, not less wonderfully, with all the tender condescension of Paternal kindness!

TENTH WEEK—SATURDAY.

III. MAN IN WINTER.—ADAPTATION OF HIS CONSTITUTION TO THE SEASON.

Besides the adaptation of external nature to the relief of man from the severities of winter, we have another proof of beneficent intention in the adaptation of the human constitution itself to the endurance of these severities. All animals are more or less endowed with this power of accommodation, yet none so much as those which are destined to be the companions and the aids of man; and man himself, assisted by the contrivances which his intellectual powers suggest, stands in this respect pre-eminent above them all. It was consistent with the beneficent intentions of the Creator, that the only rational race of beings on our globe, should be dispersed over every climate, and should carry intelligence and mental enjoyment, and a heart capable of feeling and acknowledging the Almighty Benefactor into every corner of the earth. We accordingly find, that the human frame can exist, not only under the vertical sun of the tropics, but under the chilling blasts and wide-spread snows of the polar regions.

It may be difficult for the physiologist to discover in what this power of accommodation lies; but, that it does actually exist in a remarkable degree, the slightest acquaintance with the history and condition of the human race demonstrates. Every climate, indeed, and almost every country, exhibits some peculiarity in the constitution, and even in the external appearance, of the inhabitants, which indicates this power. The well known varieties in the colour of the skin, with its different shades of white, yellow, red, brown, and black, is an example of this. The colour of the eyes, and of the hair, and the shape of the nose, the cheek-bones, and the lips, are other familiar instances of a distinction of races in connexion with food and climate, as well as other local circumstances. I mention these as mere indications, for I do not know how far, or in what respects, any of them contribute to the accommodation in question. But the profuse perspiration of the Negro, under the heat of the tropics, and the stunted growth, and thick-set form of the Laplander, and native of Greenland, where food is scanty, and the cold intense, are less equivocal marks of wise and beneficent design. The perspiration diminishes the heat of the one, while the concentrated frame of the other preserves the animal warmth; and, while it probably increases the bodily strength, and thus gives additional power both of exertion and endurance, affords the faculty of existence on a diminished quantity of food. The state of the Negro is well known, and therefore need not be dwelt on; but, as the condition of the inhabitants of the polar regions is less familiar to the public, and comes more immediately under our present subject, it may be proper to show how far the view we have taken of their bodily constitution corresponds with their known habits and powers. Goldsmith, following Buffon, gives a most unamiable account of the personal appearance of the inhabitants of these inhospitable countries, including, under one description, the Laplanders, the Esquimaux Indians, the Samaoid Tartars, the natives of

Nova Zembla, the Borandians, the Greenlanders, and the Kamtschatkans. His description of their habits, however, shows them to be powerful, active, and patient of fatigue, cold, and hunger, to a remarkable degree. Speaking of the Laplanders, he says, "They make use of skates, which are made of fir, of nearly three feet long, and a half broad. With these they skate on the icy snow, and with such a velocity, that they very easily overtake the swiftest animals. With these skates they descend the steepest mountains, and scale the most craggy precipices; and, in such exercises, the women are not less skilful than the men. They have all the use of the bow and arrow, which seems to be a contrivance common to all barbarous nations; and which, however, at first required no small skill to invent. They launch a javelin also with great force, and some say that they can hit a mark no larger than a crown, at thirty yards distance, and with such force as would pierce a man through."

In reference to the whole race of the inhabitants of the extreme north, this author observes, that, "in proportion as we approach the pole, the size of the natives appears to diminish, growing less and less as we advance higher, till we come to those latitudes that are destitute of all inhabitants whatever;" and then he adds the following interesting and characteristic account.

"The wretched natives of these climates seem fitted by nature to endure the rigours of their situation. As their food is but scanty and precarious, their patience in hunger is amazing. A man who has eaten nothing for four days can manage his little canoe in the most furious waves, and calmly subsist in the midst of a tempest that would quickly dash a European boat to pieces. Their strength is not less amazing than their patience. A woman among them, will carry a piece of timber, or a stone, nearly double the weight of what a European can lift."

This general statement, which is intended to apply to several distinct tribes, is probably pretty accurate, so far

as it goes, though perhaps somewhat overcharged. Recent voyages and travels have made us better acquainted with the people of those regions, and some interesting facts, both with regard to the character of the inhabitants, and their mode of life, have come to light, as well as with regard to the peculiarities of soil and climate, and the nature of animal and vegetable productions, of which, in a few subsequent papers, we shall avail ourselves. Meanwhile, the reader cannot fail to be struck with the peculiar arrangements by which the most rigorous climates are accommodated to the subsistence of man; or to perceive, in these arrangements, the most distinct traces of an Intelligent Designer. It is true that, in the extremes both of heat and cold, there seems to be something unfriendly to the development of the mental powers; but still it is cheering and instructive to see every where provision made for that rational being, whom, of all his sublunary works, the Creator has endowed with faculties capable of discerning Himself, and offering up the thanksgivings of creation.

ELEVENTH WEEK—SUNDAY.

THE UNCEASING AND UNIVERSAL PROVIDENCE OF GOD.

There are many associations connected with this season of the year, which lead the religious mind to look back on past events, as well as forward to the future, in reference to the operations of that Divine Being, in whom we live and move. In contemplating these, we see a thousand things which, even to our diminutive understandings, appear to be insignificant, and a thousand more which seem to have happened contrary to reasonable expectations. Such considerations induce us to inquire if it be indeed true, that a God of infinite perfection presides over these events, and occupies Himself with the minute concerns of the little world we inhabit. The inquiry is at all times interesting.

It has already been remarked, that the perfections of the Godhead are manifested, not only in the large and magnificent scale of operations, to which the view of the starry heavens introduces us; but just as clearly and convincingly in the smaller, and, to our limited apprehensions, less important, arrangements of our terrestrial globe. Numerous evidences of this truth have come under our notice, in the compensations, adjustments, and contrivances by which the general welfare of living beings is provided for, even in the bleak season of winter, and under circumstances apparently the most unfavourable.

Nor is it in created objects themselves, alone, but in their daily history also, that the same character is to be perceived; for the God who made, continues to preserve His creatures; and the same Hand, which wheels the planets in their orbits, and orders and arranges their daily positions, and their mutual attractions, is as di-

vinely occupied in preserving the various races of His terrestrial offspring, and in directing the daily occurrences by which their individual experience is distinguished.

That the Almighty watches over each of the beings He has made, and appoints its situation and its history, in all their varied vicissitudes, seems to follow from the fact, that He at first saw fit to create it; for, to imagine that God should have formed any creature, without having previously arranged the uses to which it should be put, the place it should occupy in the economy of creation, and the mode by which it should contribute to the advancement of His glory, is just to suppose Him such a one as ourselves,—ignorant and unsteady, fluctuating in his designs, and capricious in his conduct. Nor does the meanness of any of the creatures affect the question. The fact, that it has been esteemed worthy to be made, establishes the other fact, that, so long as it exists, its movements and its history must be ordered and superintended by God; and that the least noticed and most ordinary occurrences connected with it, are under His control. It requires, for this minute care and superintendence, no greater condescension, than for its original formation; and, if it be granted, that God is not degraded by the latter, it is inconsistent to imagine any degradation to attach to the former.

To every argument, therefore, used to support an opposite conclusion, it were enough to reply, that, as it is God's to create, so it is His to uphold; and though to some of the creatures has been assigned a nobler place, and a higher destiny, than to others, the meanest, as well as the most exalted, must receive from God whatever care is necessary to enable them to fulfil the designs for which they were created. The seraph has his place assigned amid the glories of the celestial palace, where he is for ever and ever hymning the praises of his Creator. The pebble of the brook, whether it lies perpetually unnoticed among the stones in which it was originally imbedded,

or serves, in the hand of one under the Divine guidance, like that used by the stripling David, to smite an enemy of God in the forehead, has been made, and has had its place assigned, by the same infinite Jehovah. Both are equally the property of God, and each, in its own allotted place, is equally well suited for the ends for which it was intended. Both, therefore, are under the care of God, and each will be so ordered and guided, as to promote His eternal designs. That view of God's providence, which, affecting to place Him above the contemplation or the care of His creatures, however small or insignificant they may appear to us, divests Him of the glory attending the daily preservation of so many minute wonders, can only be adopted by one whose ideas of value are formed on the gross supposition, that bulk constitutes importance, and whose intellect is incapable of grasping the fact, that, to the mind of God, whatever we can perceive of the vast and magnificent in creation, is but, after all, a point, requiring for its maintenance no greater trouble or care at His hands, than the little fly, which dances in the sunbeam, or the inanimate clod, which we tread beneath our feet.

From this doctrine may be deduced a sufficiently obvious, and no less important lesson—a lesson of faith and dependance on that God, by whom all things are arranged and governed. If even the tiniest insect is thus under His care, how much reason have we to feel satisfied that He will care for us. Such was the instruction deduced by our blessed Lord, from the same subject:—"Behold the fowls of the air, for they sow not, neither do they reap, nor gather into barns; yet your heavenly Father feedeth them. Are ye not much better than they? Consider the lilies of the field, how they grow; they toil not, neither do they spin. And yet I say unto you, that Solomon, in all his glory, was not arrayed like one of these. If God so clothe the grass of the field, which today is, and to-morrow is cast into the oven, shall He not much more clothe you, O ye of little faith?"

The providential care manifested toward us by our Creator, is shown not only in the greater and more important events, but in every circumstance by which our lot is varied, however minute, or however trivial;—in the casual meeting of a friend, which seems to lead to nothing, as well as in the circumstances immediately connected with our birth, our conversion, our marriage, or our death. This will be the more readily granted, when it is perceived, that the distinction between trifling and important events cannot be accurately made by us, and that those which would generally be classed among the former, are very frequently the fruitful parents of the most momentous occurrences.

We need not go far for an illustration of this subject. It is a point, for example, in undisputed history, that Mahomet, when pursued by his enemies, ere his religion had gained a footing in the world, took refuge in a certain cave. To the mouth of this retreat his pursuers traced him; but, when they were on the very point of entering, their attention was arrested by a little bird, starting from an adjoining thicket. Had it not been for this circumstance, the most trivial that can well be conceived, which convinced them that here the fugitive could not be concealed, Mahomet would have been discovered, and he and his imposture would have perished together. As it was, he effected his escape, gained the protection of his friends, and, by the most artful course of conduct, succeeded in laying the foundation of a religion, which now prevails over a large portion of the world, and numbers among its votaries the inhabitants of lands, neither insignificant in the map of the world, nor unimportant in their political relations. Thus, to the flight of a sparrow, may be traced the establishment of a delusion, whose moral influence has been deeply felt in the world, for more than one millenium already, and probably will continue to exert a baneful effect on the character of many a people, till the very eve of that blessed period, when the kingdoms of this world

shall become the kingdoms of the Lord, and of his Christ.

If an occurrence such as this has been so fruitful of events, to what circumstance shall we venture to give the name of trifling? Does not the history of every one of us bear record how strong is the influence of the very smallest and most unheeded of the occurrences by which it has been marked? Has not the falling of a leaf, or the waving of a branch moved by the gentle breath of heaven, suggested a thought, or led to a resolution fraught with important consequences to our future lives? And who can tell the thousand—thousand links, minute and unremembered, which have every one been necessary, in its own place, to bring about the end which has at length occurred,—the strange coincidences, the apparently accidental events, the meetings, the surprises, the conversations, the reflections, the very moods of minds which have entered into the composition of the final act, and which, had any one of them been different, even though that one had been the least noticed among the preparatory steps, must have led to a different result.

And, then, as to the importance of the chief events in the life of the humblest citizen, who can tell what an influence these may indirectly exercise over the happiness of his neighbourhood, or the fate of his country, or the destiny of the world? Had Hampden's spirit never been excited by the injustice of his rulers, who can tell what form of tyranny might now have been swaying the sceptre of our native land? and had Britain, at that era, slept on in her chains, instead of shaking off the yoke of her oppressors, who can say whether any nation in the world would at this moment have been free?

Thus constant, thus minute, is the providential care of God. As He is wise, let us trust Him for the ultimate adjustment of whatever appears to our short sighted vision, either distorted or unworthy of His character. As He is good, let us entertain the confidence, that they who serve Him in the gospel of His dear Son, shall be brought

through all the vicissitudes of their earthly history, safe to the eternal mansions at last, and that, dark as the experience of His saints may be, He will cause all things to work together for their real good. G. J. C. D.

ELEVENTH WEEK—MONDAY.

I. ON THE INHABITANTS OF THE POLAR REGIONS.

We are naturally led, from the contemplation of man in winter, to view him placed, by the hand of Providence, amid the horrors of the Frozen Zone, where summer hardly ever penetrates, even in its least striking characteristics; where the solar heat is barely sufficient to dissolve, for a few months, the superficial snow on the lower grounds, or the southern slopes, and to awaken the vegetable world to so languid a life, that even the hardier tribes of herbivorous animals find, though in diminished numbers, but a meagre subsistence. It would be difficult to conjecture any inducement which could have led originally to the voluntary occupation by man, of so inhospitable and sterile an abode; and we are almost constrained to rest in the idea, that, in the accomplishment of the Divine intention of peopling the globe, the Supreme Governor has urged mankind, by some mysterious impulse, independent of his natural inclinations. Furnished with a power of accommodation to all climates, and aided and prompted, no doubt, by circumstances, man has often unconsciously fulfilled the first command of his Creator, "Be fruitful, and multiply, and replenish the earth." Issuing from the Plain of Shinar, to every point of the compass, the human race, after filling up the fertile regions of the Asiatic continent, radiated thence toward all the quarters of the globe; till, after the lapse of ages, they had brought the most inhospitable regions, and most distant islands, un-

der their dominion. In this process, even the wastes of Siberia, and the snowy deserts of Boothia Felix, received a portion of the human family. God, by whom they were conducted, and who had implanted within them an indomitable perseverance, and an amazing versatility of mind, had also prepared for them, even there, the means of subsistence; and, though hardships were to be encountered, and difficulties to be overcome, of which the inhabitants of more favoured climes were ignorant, there was spread for them, in the various kingdoms of Nature, a provision ample enough to satisfy all their real wants.

In illustrating this subject, I shall turn my attention, exclusively, to the state and character of those nations who are known by the general name of Esquimaux, and who dwell in the most northerly regions hitherto discovered, I mean the lowest latitudes of the Continent of America. Consulting those enterprising adventurers who have, in later years, penetrated the frozen seas, or wintered among the snows and storms of this extreme portion of the world, we shall thus be brought to understand how ample are the resources of Providence, even in the very coldest portions of the world; and, *a fortiori*, how rich must be the provision made by the Creator, in countries where the frost is less intense, and the rigours of the climate less severe. We shall find that objects, which, in temperate latitudes like ours, are regarded as useless or troublesome, are there capable of being turned to the most valuable account; that the snow, for example, which, to the delicate foot of the luxurious Europeans, is cold, and damp, and disagreeable, grows in importance as we travel toward this ultimate corner of the earth. In the back woods of Canada, during the grim reign of winter, it affords the only means of transporting the produce of the land; and, what is very remarkable, forms a hard and easy path, for this purpose, at the very season when the convenience of the agriculturist demands it. But, in the native country of the Esquimaux, we shall find its value infinitely enhanced, affording shelter and

warmth, as well as the facilities of easy transit. It is true, we shall not discover, in these wild and miserable districts, accommodations either so choice or so convenient as in temperate regions: Nor will our general argument thus be weakened. God, who has arranged the various conditions of the different orders of His creatures, has kindly bestowed upon some, advantages which he has seen meet to withhold from others; and, while we perceive, that this is but consistent with the general system of His Providence throughout our degenerate world, it is enough for us to know, that, even amid the blackness and horrors of an arctic winter, we can find ample reason to adore that Goodness, which, under circumstances apparently hopeless, has provided a sufficiency for the sustenance of a considerable proportion of His rational creatures.

The grand necessities of that remote people, then, may be considered under the several heads of Food, Clothing, Dwellings, Fire, and Light.

1. The daily food of the Esquimaux, as may well be supposed, is not directly derived from the soil. The land, perhaps in itself sterile, and at all events incapable, from the severity of the climate, of yielding a remunerating return for its cultivation, lies undisturbed by the hand of man, in all its original barrenness. Its spontaneous productions are few and of small value.

When the snow melts from the surface of the earth, it is found clothed with a stunted herbage, consisting chiefly of short coarse grass, affording a sufficient meal to the tribes of animals, which, during the winter months, had migrated to less sterile countries, but offering little to satisfy the cravings of the human appetite, and still less to invite to the indulgence of a luxurious taste. A few of the vegetable productions, indeed, are occasionally employed by the natives; but they are neither depended on, as necessaries of life, nor cultivated for domestic purposes. Under these circumstances, this hardy people are driven to the resources afforded by the animal produc-

tions, with which, happily, their country abounds. Of these we may mention several of the more remarkable. The smaller species of rein-deer which, in summer, are found in considerable numbers over the most northerly districts of America, and even among the islands of the Arctic Ocean, which they reach in spring by crossing the yet unbroken ice, offer them a delicious banquet. These animals are tracked through the snow with that zeal and perseverance which generally characterize the hunting excursions of a barbarous people; and, notwithstanding their proverbial fleetness, fall victims, in great numbers, to the sure aim of the Esquimaux archers. The musk-ox is one of those animals peculiar to a very cold and inhospitable latitude; and though, being sometimes of a savage temper, he needs to be approached with caution, is constantly pursued, as affording a principal article of food to the inhabitants of these regions. At certain seasons, indeed, the flesh of this animal possesses a very strong and unpleasant flavour of that odorous production from which its name has been derived; but, in general, it is highly palatable, and has often been eaten with relish by Europeans, who describe it as very similar in taste to beef. To these may be added the hare, the wolf, and the fox; the two last of which are caught in ingenious traps, baited with fish, or any sort of animal garbage, and are readily attracted to the neighbourhood of the snare, by setting fire to a little rancid oil or refuse fat. The flesh of the fox, strange as it may appear, is not only much esteemed by the Esquimaux, but even by European travellers, who, when fresh provisions were scarce, have often partaken of it with relish. In addition to these quadrupeds, it need hardly be remarked, that the Esquimaux are furnished, by the hand of their bountiful Creator, with an immense and most valuable supply of fish. The enormous whale, and the delicious salmon, the walrus, and the seal, are all made tributary to their daily necessities. They have exerted their ingenuity in the preparation of the staves, the spears, and

other instruments employed in their capture; and these, though far indeed from the perfection exhibited in the tackle of a European, manifest a greater share of the inventive faculties than we could easily have believed to belong to so rude and ungainly a people.

The immense quantity of fish taken and preserved by them, every season, for the supply of their winter necessities, almost exceeds our belief. But the contemplation of the exuberant abundance which their stores supply, while it leads to the conclusion, that no portion of the globe is so wild or so inhospitable as to be destitute of proofs of the care and rich bounty of our Heavenly Father, awakens within us a sentiment of adoration, as well as of astonishment. "The earth is *full* of his goodness."

ELEVENTH WEEK—TUESDAY.

II. ON THE INHABITANTS OF THE POLAR REGIONS—FOOD AND CLOTHING.

We have seen, that the inhabitants of the Polar Regions, shut up, though they be, amid the icy lakes and mountains of the Frozen Zone, and suffering, even during the summer months, under a state of the atmosphere more rigorous than that which generally accompanies a British winter, have not been neglected by their kind and bountiful Creator. The vegetable world, it is true, affords them but few of its productions, either to please the palate, or to gratify the appetite; but, along their barren hills, and within their ice-bound seas and rivers, an ample supply of food exists, to satisfy the daily returning necessities of this peculiar people.

It is generally admitted by physiologists, that the activity of the human body, in the generation of internal heat, though dependant, in a great degree, on the original constitution, is powerfully affected by the quality,

as well as the quantity, of the food consumed. It would moreover appear, that, to excite the heating powers of the living principle in man, there is nothing found by experience so valuable as an oily diet. In temperate regions, this fact is recognized by medical men, in cases of protracted rheumatism, in which the regular use of the oil extracted from the liver of the cod, is found highly beneficial in bracing the system to resist the effects of external cold, and enabling it, by an increased action, to banish the gnawing pains of that distressing complaint. Any one can tell how much, on exposure to the cold of a winter day in our own climate, hunger increases the chilly sensations of the body, and how much comfort a sufficiency of animal food is calculated to afford. A meagre diet is best adapted to a warm climate or season, agreeing well with the relaxed state of the body under an equinoctial sun, or the parching heats of summer; but affording no defence against the bitter effects of a severe frost. I believe it has been frequently remarked, by persons familiar with the Polar Seas, that sailors, of a full habit of body, a sanguine temperament, and a florid complexion, if in good health, are the least affected by the feeling of severe cold; and these are just the men most generally addicted to eating considerable portions of animal food. A thin and bilious person, on the other hand, who eats sparingly, and loathes a large proportion of fat or oily substances, finds it painful to be long exposed to the chilling influence of a northern sky. How remarkable an example of Divine Providence, then, does it appear, that, in those very regions where the internal heat of the body needs most to be excited, an inexhaustible supply exists, of the very description of food best suited to the purpose; and that, where the warmth of a summer sun never summons, from the chilled and benumbed earth, a vegetable provision for the calls of the human appetite, there should be found—what is far better—the oils and the fat with which the Arctic province of the animal kingdom so pe-

culiarly abounds; and that with this abundance there should also co-exist a relish, on the part of the inhabitants, for substances, the mere odour of which, in the chamber where they are to be partaken of, is sufficient to expel with disgust a native of this country; or, if he cannot make his escape very speedily, to affect him with nausea or fainting. The incredible quantity of this description of food, often rancid as it is, which an Esquimaux is capable of devouring at a meal, has excited the astonishment of all Europeans by whom it has been witnessed. Twenty pounds of salmon, for instance, is stated as no uncommon quantity to be devoured by an individual at a single meal. This excess, indeed, is followed, among them, as well as in more civilized nations, with its own punishment; but there can be no doubt, that the cold of these regions is materially deprived of its painful effects on the human frame by eating as largely as nature will easily permit; so that the tendency to make a full meal, which is universally exhibited among them, and is no doubt a part of their constitution, must be looked upon as a collateral provision of the same wise over-ruling Power, liable indeed to abuse, but, when rightly regulated, calculated to promote the welfare of this distant people.

2. The *clothing* of the Arctic tribes, and especially of the Esquimaux, is almost entirely composed of furs. Providence, which has kindly adapted the coats of the lower animals in these regions, to the rigours of their climate, has thus, at the same time, brought within the reach of man the means of a warm exterior defence from the cold to which he is exposed.

Neither the flannels of more civilized countries, nor the skins of more southern climates, are at all to be compared to the valuable clothing with which, by the same exertion and ingenuity which are requisite to procure their food, they are furnished, among the hills and islands of their icy home. The long hair, which gives to the white bear and musk-ox their shaggy aspect; the rough

coat of the rein-deer, the hare, and the fox, cover a close warm downy inner garment of fur, rendered thicker by the first severe onset of winter, which effectually preserves the animal, for which it was originally provided, from the intensity of the northern storms; and, when snatched from its first owner by the lord of the lower world, affords to him a similar protection. Clothed in a double garment of deer-skin, encircling the body, and reaching in front from the chin to the middle of the thigh, and behind to the calf of the leg, with sleeves so long as to cover the points of the fingers, with the hair of the inner garment, as a warm exciting covering, next the body, and that of the outer one, from its roughness, extremely unfavourable to the radiation of heat, in the reverse direction; his limbs protected by two pairs of boots, and, above these, trowsers of the skin of the seal or of the deer,—an Esquimaux can endure, without danger or inconvenience, a degree of cold, to which we, in this temperate zone, are not only strangers, but of which we can hardly form a conception. Nor are we to imagine, that the piercing climate, which has imposed the necessity for such defences, has had any effect in souring the dispositions, or lessening the enjoyment, of this singular race. On the contrary, they have generally been found remarkable for their good humour and easy temper. Their very dresses, frequently ornamented with fringes of leather, or tassels of bone, bear testimony that the hardships of their lot have neither cramped their taste, nor stifled their natural love of ornament. With an air of freedom and of personal comfort that can hardly be believed, while he enjoys the protection we have just described, the hardy native courageously braves an intensity of frost sufficient to congeal mercury. He proceeds on his journey, or pursues his prey, with a hilarity and keenness which testify, that the Being who ordered his lot among the horrors of his icy abode, has also afforded him ample means of defence and of enjoyment.

G. J. C. D.

ELEVENTH WEEK—WEDNESDAY.

III. ON THE INHABITANTS OF THE POLAR REGIONS.—DWELLINGS AND FIRE.

3. In all climates, but more especially in the extreme north, it is a matter of indispensable importance to the inhabitants, to provide for themselves shelter from the inclemency of the weather. The lengthened journeys which these tribes are compelled by their necessities to undertake, the frequency of their removals, and the obliterating effects of falling snow, all tend to render it at once inconvenient and useless for them, even were it practicable, to erect permanent dwelling-places. Had they wood, stone, and mortar at command, these materials would be to them of little avail. The villages of to-day, deserted to-morrow, and next day buried many feet beneath the snowy covering which enveloped, for so large a proportion of the year, the surface of their country, would, ere their return, be altogether useless, even if they were sure, at the end of several months, to find the spot on which they stood. But we need not say that such appliances as these are not within their reach. The wreck left by the southern wave, when it washes their shores, may sometimes, indeed, provide them with a tree, a mast, or a spar; but these materials are too eagerly coveted, and too valuable, for constructing the smaller articles required by them, to leave any sufficient proportion for such purposes as building; while, of the architectural uses of stone and lime, they seem to be altogether ignorant. But, for all these wants, they are furnished, by the protecting Providence of God, with an ample and highly appropriate substitute, however strange it may appear to the inhabitants of temperate regions. The snow which covers the soil for by far the greater proportion of the year, offers them the refuge which

their necessities require. Migrating, as they do, from time to time, in search of food, at the close of each day's journey, they erect their temporary dwellings, at little expense either of materials or workmanship; and, when they reach the station which they propose to occupy for a few months, even then their mode of building is of the simplest sort. It is thus described by Sir John Ross:—"Having ascertained, by the rod used in examining seal-holes, whether the snow is sufficiently deep and solid, they level the intended spot by a wooden shovel, leaving beneath a solid mass of snow, not less than three feet thick. Commencing, then, in the centre of the intended circle, which is ten feet or more in diameter, different wedge-shaped blocks are cut out, about two feet long, and a foot thick, at the outer part; then trimming them accurately by the knife, they proceed upward, until the courses, gradually inclining inwards, terminate in a perfect dome. The door, being cut out from the inside, before it is quite closed, serves to supply the upper materials. In the mean time, the women are employed in stuffing the joints with snow, and the boys in constructing kennels for the dogs."* In the interior, the only furniture that is to be seen, consists of a sofa of snow, occupying nearly a third of the breadth of the area, about two feet and a half high, level at the top, and covered with various skins, forming the general bed or sleeping-place. The hut is lighted by a window of ice nicely inserted in the building, and secured by frozen snow; and the entrance is by a passage, long, narrow, and crooked, the outer aperture of which is planned, and from time to time altered, so as to secure the inmates from the prevailing winds of the season. The stores are laid up in smaller huts, constructed to receive them; and they, and the kennels for the dogs, which invariably accompany the tribes, are formed of the same material. It will naturally be conjectured, that such dwellings as have now been described, must be extremely cold, and liable, on

* Voyage, p. 298.

any accession of artificial heat, to be rendered altogether uninhabitable, by the perpetual distillation of water from the icy walls. But there are several considerations which must be taken into the account, to enable us to judge of the suitableness of these habitations for the hardy race who occupy them. It must be noticed, in the first place, as a most important provision for their comfort, that snow is a very imperfect conductor of heat. The severe cold of the external air, therefore, makes but a small impression on the temperature of a chamber situated beneath a snow-wall of considerable thickness. Then, from its extreme whiteness, it is, comparatively speaking, little liable to be dissolved by the heat of a lamp or fire, being much more ready to reflect caloric than to absorb it. These facts, however, striking as they are, it is clear, could not prevent the most annoying effects, were a strong heat constantly kept up within their circumscribed apartments. But here we find another important provision. The bodily frame, in all latitudes, speedily becomes inured, by habit, to the climate to which it is exposed, and the standard of temperature requisite for comfort accordingly rises or falls, as we live nearer the equator or the poles. While the African shivers under the summer-warmth of the temperate zone, a degree of heat scarcely sufficient to raise the mercury to the freezing point, affords to the patient Esquimaux, in his snowy hut, quite enough of warmth to make him comfortable; and, even if the temperature should, at times, be raised so high as to promote a rapid distillation from the walls, his ideas of luxury do not render this a very serious inconvenience. When we remember that it is not luxury which these rude tribes value, but simply shelter, we shall be less surprised with their contentment, especially when we learn that their clothing affords them sufficient security against the wetting influence even of melted snow. They experience quite as much of comfort as they desire, in finding themselves, during sleep, snug in their bags of fur, though

the spot on which they lie be neither very dry nor very soft; for this defence, provided for them by the care of their Divine Preserver, answers to them all the ends for which it is needed.

4. In a region such as this, of frost and snow, of storm and tempest, it will easily be believed that the inhabitants are very dependant on fire, as a means of sustaining life; and the question will at once suggest itself, Whence can they derive fuel? Coals are unknown to them; and wood, we have seen, is much too valuable to be used for such a purpose. But they are not left destitute. Their little chambers are illuminated, during the whole course of their lengthened winter, by the cheerful, warm, and useful blaze of the lamp, which is replenished by oil from the seals yearly destroyed, in immense multitudes, by the native hunters. We have seen how valuable to the natives of these Arctic Regions, is the oily nature of their diet. Here, however, we find that Providence had another end in view in affording to the inhabitants of these countries so large a suppy of fat and oil as that which is obtained from several of the cetaceous tribes which frequent their stormy seas. Nor is this an end less essential to the preservation of human life. There, where no other fuel could be had, and where, without fire, the race of men must soon have become extinct, were fixed these living reservoirs of combustible fluid, which it only needed the exercise of reason, of perseverance, and of ingenuity, to bring within the power of the human family; by which a provision has been made for their wants, infinitely better suited to the circumstances of their lot, in their inhospitable deserts, than any other description of fuel that could be named. Coals would have required the assistance of large beasts of burden, and the convenience of roads to remove them from the pits to the places where they were to be consumed, and the very nature of the climate rendered both of these equally impossible to be obtained. Wood, even supposing it could have been had, would have been al-

most as inconvenient; but the seals are generally to be met with readily, and killed with ease, affording, for a moderate degree of labour and of ingenuity, not only an ample banquet, but a very considerable quantity of the best oil, to feed the flame on which their food, their drink, and their comfort mainly depend. How can we contemplate such facts as these, without admiring the goodness and the care of that God who has so liberally furnished the means of subsistence, even in this wild, desolate, and barren country! G. J. C. D.

ELEVENTH WEEK—THURSDAY.

I. FROST.—PROVISION FOR CAUSING ICE TO FLOAT ON THE SURFACE.

Without heat, every thing would be solid; the true way, therefore, of viewing liquids, is to consider them as solids in a melted state. Bodies melt at different temperatures, according to their capacity of receiving heat, and to the nature of the action which this subtle principle produces on their particles. Thus, it requires one degree of intensity to melt stone, another to melt iron, another to melt lead, and another still to melt ice. In this view, ice may be considered as the natural state of the element, and water to be nothing else than ice rendered liquid, like other substances, by heat. When the short continuance of the sun above the horizon in winter, and his oblique rays, have greatly diminished the force of his influence, he is no longer able to preserve water in a liquid state, and then the process of crystalization takes place, and ice is formed. But there is a remarkable difference between ice and other solid bodies, in the laws regulating its passage from a liquid to a crystalized state, which manifests beneficent intention.

Take water in its common state, and observe what occurs in reference to heat. It is the property of water, in common with other liquids, to communicate heat not so much by *conduction*, as it is called,—that is, by transmitting the temperature from particle to particle,—as by a motion among the particles themselves. Liquids, like solids, expand by heat and contract by cold. When heat, therefore, is applied to the bottom of a vessel, the expansion diminishes the specific gravity of the particles affected by it, and they rise to the surface, giving place to the colder and heavier particles, which again are heated in their turn, and ascend; and thus the process proceeds, till the whole liquid is of equal temperature. In cooling, the opposite process takes place; the particles, as they become colder at the surface, subside, while others, of higher temperature, supply their place, and this interchange and mixture goes on till the whole body of the liquid becomes as cold as the surface. This remarkable property we have already noticed in speaking of the effect of the waters of the ocean in mitigating the temperature of different climates. Let us now see what would be the consequence if the same laws were to hold without limitation or exception. The cooled particles constantly descending, in virtue of their relative specific gravity, would, when the freezing point was reached, suddenly convert lakes and rivers, and the bed of the ocean itself, into a solid mass of ice, the congelation beginning at the bottom, and quickly spreading upward. Nor, when our deep waters were once frozen, would there be any natural means in existence by which they could be thawed to the bottom, because, the heated particles being the lightest, would constantly float at the top, and the warmth could only be diffused, as it is in solids, by the slower and less equable means of conduction. The experiment has been made, and water has been caused to boil by the application of heat to a vessel partly filled with ice, without thawing the congealed cake below.

Now, this would be attended with many disadvantages. The utility of our seas and lakes, in our own and similar latitudes, would be destroyed as means of commerce and of subsistence; and that element which, by its equal and mild temperature, contributes so essentially to the salubrity of all climates, from the tropics to the polar regions, would serve only to chill the atmosphere, and render even our temperate climates inhospitable.

What is worthy of serious attention, is the modification of the law by which this inconvenience is provided against. Water continues to contract by the application of cold, till it approaches the freezing point; but here a most remarkable deviation takes place. When it has cooled down to 40°, instead of continuing to contract, it suddenly begins to expand, and it proceeds in this new course, till, at 32°, it becomes ice. The fluid is, therefore, at its greatest density, when its temperature is just 8° above the freezing point; and hence the bottoms of our seas and lakes will be generally found, in winter, not to exceed that extent of coldness.* The coldest water, as it approaches the freezing point, rises to the surface. There the ice is formed, exposed to the first return of a more genial temperature, and ready to dissolve with the earliest influences of a warmer sun.

Another remarkable circumstance, which secures the floating of ice on the surface of the water, is, that in the very act of freezing, a further expansion takes place. By this operation, the specific gravity of ice becomes less than that of water under any circumstances, and it is thus prevented from sinking to the bottom. Did no expansion take place in the process of congelation, ice would continue to float only so long as the water on the surface of which it was formed remained below the temperature of 40°. If the temperature happened to be raised above this point, it would immediately sink, and

* It seems unnecessary to notice some remarkable facts which have lately attracted public attention, that appear somewhat to modify this conclusion, ice having been found formed at the bottom of some deep lakes.

be overwhelmed, giving rise to various inconveniences, though not of so formidable a nature as those already alluded to.

It is not easy for the most sceptical to avoid the conclusion, that the marked and salutary deviation in this case, from the law by which matter is expanded by heat and contracted by cold, is an arrangement of an intelligent and beneficent Creator. The general rule is followed down to the point where it ceases to be beneficial; and then, by a sudden and surprising change, the very opposite rule takes place, by which disastrous effects are prevented, and various important advantages are secured. Where could we look for a clearer or more satisfactory proof of wise contrivance?

"We do not know," says Whewell, "how far these laws of expansion are connected with, and depend on, more remote and general properties of this fluid, or of all fluids. But we have no reason to believe, that by whatever means they operate, they are not laws selected from among other laws which might exist, as, in fact, for other fluids, other laws do exist. We have all the evidence which the most remarkable furtherance of important purposes can give us, that they *are* selected, and selected with a beneficial design."*

ELEVENTH WEEK—FRIDAY.

II. FROST.—THE EXPANSIVE AND NON-CONDUCTING POWER OF ICE.

Our attention was yesterday directed to some of the peculiar provisions by which the freezing of water is so modified as to prevent the fatal effects that would ensue

* Bridgewater Treatise, p. 85.

were the general law of expansion and contraction which regulates heated bodies, to operate without being arrested and altered. But there are one or two other beneficial operations of frost in our climate, which must not be passed without notice.

The expansive power of water, when passing into ice, has already been stated. This power operates with great force, as has been ascertained by experiment. A familiar instance occurs in the bursting of bottles filled with water or other liquids, when corked up and exposed to its influence. The same power affects the soil, when saturated with moisture, heaving up and separating the particles of earth and gravel. This sometimes acts disadvantageously, by throwing out the plants of young wheat, and by loosening the materials of which our roads are composed; but it amply repays these partial inconveniences, by its pulverising effects on tenacious soils. Stiff loams, as they are called, that is, lands chiefly composed of an unctuous clay, though abounding in the vegetative principle, are yet naturally in an unfit state for successful cultivation. Their tenacity prevents the absorption and removal of the superfluous moisture during rainy seasons, and in drought renders the soil so indurated, as to obstruct the free growth of the roots of plants, and the secretion of sap. Now the agriculturist knows how to obviate these disadvantages, by the exposure of this kind of soil to the influence of frost. He ploughs up his land into furrows; and, by thus presenting it to the freezing process, finds that the water mingled with the soil, as it expands in being converted into ice, separates, with irresistible force, the adhesive particles of the clay; and, when again contracted, and rendered liquid by thawing, leaves the earth finely pulverised, and brought into a state well fitted for giving forth its prolific qualities in the ensuing year.

Another beneficial property of frost in the form of ice as well as of snow, is the power it possesses of confining the cold to the surface of the earth. The ice binds up

the soil, and being a slow conductor, prevents the severity of the season from injuriously affecting the fibres and roots of the plants which nature has, in general, buried to a sufficient depth for their preservation, with the aid of this wise provision. Even when the ice reaches and envelopes the roots, it seldom materially injures them, because it does not easily descend below the freezing point, which is much higher than the usual temperature of the air in northern winters.

Here, again, we find cause of pious admiration. We do not expect a world of perfection; but the contrary. All climates have their inconveniences and evils: such is the condition of a fallen world; but then these disadvantages are always, in a wonderful manner, guarded, limited, and mitigated. They proceed to a certain point; but there a Paternal hand interposes; and the sentence is pronounced as distinctly as if it were proclaimed with an audible voice, "Hitherto shalt thou come, and no farther." The obvious intention is discipline, and not destruction. In tropical climates, for example, the heat of a vertical sun, as we have seen, is not permitted to accumulate, by perpetual action on one point, as it would thus become intolerable. That great source of light and warmth is made continually to traverse from tropic to tropic; and when his direct rays would strike too fiercely in his passage there, the clouds collect with their shade, the rising winds fan the air, the cooling and fertilizing rains descend, and thus he moves along in his tempered glory, showering blessings from his wings at the moment when he threatened to scorch and destroy. And a similar arrangement is observable with reference to the opposite extreme of intense cold. The wintry blast seems calculated utterly to exterminate both the vegetable and animal creation; but by a series of deeply excogitated contrivances, the calamity is averted, and life and vigour are preserved in the vegetable world, while comfort and enjoyment are communicated to every thing that lives.

How curious and edifying is the analogy between the works of creation and the operations of Divine grace,—between the revelations of the book of Nature and of the book of Inspiration. When the curse fell on man, it was mitigated by the promise, that "The seed of the woman should bruise the head of the serpent;" when the earth was forbidden to yield him food, except as the fruit of painful toil, that very toil was converted into a source of pleasure and improvement.

Here is compensation; but grace goes far beyond the analogy of nature, for it promises heaven for earth,—the absolute and unalloyed blessedness of immortality, for the turmoils and stinted enjoyments of this mortal life. When the terrestrial paradise was closed against man for ever, his eye was directed, across a rugged and gloomy wilderness, and through a swelling flood, to that bright spot in the distant horizon, where the wicked cease from troubling, and the weary are at rest; where a Father's hand wipes the tear from every eye; and where "joy unspeakable and full of glory" eternally reigns.

ELEVENTH WEEK—SATURDAY.

III. FROST.—AMUSEMENTS CONNECTED WITH IT.

A GROUP of school-boys on the surface of a frozen pond or lake, is a most animated and interesting spectacle. There is so much evidence of real enjoyment in the motions, the accents, and the countenances of the various individuals who compose it, whether they glide along the ice on skates, or, by means of the more humble instrumentality of wooden shoes, fenced with iron, or of a staff, armed with a pike, that a spectator, accustomed to reflection, cannot fail to recognize, in the happiness

which prevails around him, an evidence of a benevolent Creator.

It might perhaps appear ludicrous, were I to assert that ice is formed smooth and hard, for the purpose of affording means of healthy and exhilarating sport to the young; and I might be reminded, that this is just the form which the crystallizing process takes in other instances, and the natural result of its laws. Be it so: but still it is impossible to deny, that the youthful mind is so framed as to take pleasure in the exercises which the smooth and level surface of the ice affords; and surely we do not go beyond the bounds of legitimate inference, when we assert, that this is one of the benevolent contrivances by which the rigours of winter are softened, whether the adaptation lie in the polished surface of the frozen plain, or in the buoyancy of the youthful mind, or in both. This observation may be greatly extended; for there is scarcely any object with which we are surrounded, that is not, to the well constituted mind, a source of enjoyment. In the young this is more conspicuous, because the pleasurable feeling lies nearer the surface, and is more easily excited, and expressed more emphatically, by outward signs. But it would be a great mistake to measure the relative enjoyments of childhood and manhood by their external expression, or to suppose that nature, even in its most familiar aspects, does not present as many objects of interest, and of agreeable sensation, to those who are in the meridian of life, or even verging toward the shades of evening, as to those who flutter in the morning sunshine.

If the ice afford to the school-boy the joy of gliding swiftly on its smooth expanse, it is not niggardly of its amusements to the more sedate minds of the mature in age. To every northern country, some amusement on the ice is familiar; and, among these, that of *curling* may be mentioned as the game peculiarly prized in many districts of Scotland; and also, if I mistake not, in the Netherlands; from which latter country it seems

to have been originally derived. The amiable Grahame, in his British Georgics, gives a graphic description of this amusement, an extract from which will not be unacceptable :—

" Now rival parishes and shrievedoms, keep,
On upland lochs, the long-expected tryst,
To play their yearly bonspeil. Aged men,
Smit with the eagerness of youth, are there,
While love of conquest lights their beamless eyes,
New nerves their arms, and makes them young once more."

* * * * * *

" Keen, keener still, as life itself were staked,
Kindles the friendly strife: one points the line
To him who, poising, aims and aims again;
Another runs, and sweeps where nothing lies.
Success, alternately, from side to side,
Changes; and quick the hours unnoted fly,
Till light begins to fail, and deep below,
The player, as he stoops to lift his coit,
Sees, half incredulous, the rising moon.
And now the final, the decisive spell
Begins; near and more near the sounding stones,
Some winding in, some bearing straight along,
Crowd justling all around the mark; while one
Just slightly touching, victory depends
Upon the final aim: long swings the stone,
Then, with full force, careering furious on,
Rattling it strikes aside both friend and foe,
Maintains its course, and takes the victor's place."

These are but single instances of the means of enjoyment, which brighten the gloom of winter. The benevolent Parent of nature enables the human mind to find a source of pleasure, as I have said, almost in every thing. Who has not felt his heart expand with an undefinable delight, when he has beheld the fantastic forms into which, during severe weather, the frozen spray or drippings of a cascade throw themselves, and when he has given loose reins to his fancy, in tracing crystal

grottoes and temples, and spires, in the endless, but always elegant varieties of the architecture which the wizard Frost had reared? The very icicles dependant from the eaves of the houses, as they glance in the morning sun, are not beheld without a pleasing emotion; and a higher gratification to the taste is afforded in contemplating the white expanse of the snow as it spreads its bright and colourless carpet over the fields, and lies thick on the bending hedges and trees, while, at the horizon, the cold marble outline of the distant hills, swelling in the softened light, is finely contrasted with the dark blue of the serene and cloudless sky. Mr Abbott, a pleasing and amiable American writer, has touched, very beautifully, on the "thousand ingenious contrivances," as he calls them, which "God has planned and executed to make men happy;" and he alludes, among other things, to the enjoyments of winter, in a few sentences, which will form an appropriate conclusion to this paper.

"You can give no reason," says he, "why the heart of a child is filled with such joyous glee, when the first snow-flakes descend. There is no very special beauty in the sight; and there are no very well-defined hopes of slides or rides, to awaken *such* joy. At fifty, the gladness is not expressed so unequivocally; but yet, when the gravest philosopher rides through a wood, whose boughs are loaded with the snow, and whose tops bend over with the burden, and looks upon the footsteps of the rabbit, who has leaped along over the ground, he feels the same pleasure, though he indicates it, by riding on in silent musing, instead of uttering exclamations of delight. Can you explain this pleasure? Is there any *describable* pleasure in a great expanse of white? Is the form of the trees, or the beauty of their foliage, improved by their snowy mantle? No! The explanation is, that God, who formed the laws of nature, formed also the human heart; and has so adapted the one to the other, as to promote, in every variety of mode, the enjoyment of the beings he has made. There is no end to

the kinds of enjoyment which God has thus opened to us every where. They are too numerous to be named; and no intellectual philosopher has ever undertaken the hopeless task of arranging them."*

* The Way to Do Good, p. 68.

TWELFTH WEEK—SUNDAY.

ON THE DIFFICULTY OF COMPREHENDING THE OPERATIONS OF PROVIDENCE.

We have been contemplating the perfections of the Creator, as exhibited in His works. Let us pause a little on this day, set apart for devotional exercises, and turn to the consideration of the same perfections, as exhibited in His moral government.

One of the first things that strikes the mind in adverting to this subject, is the difficulty of comprehending God's dealings with His rational creatures. We immediately discover, that "His ways are not as our ways, nor his thoughts as our thoughts." A peculiar mystery hangs over his operations, when we examine them in the unassisted light of reason; and although this mystery is greatly modified, it is not altogether removed, when revelation adds its clearer light. This every inquiring mind must have felt, in considering the various questions connected with the existence of moral evil. Let us look, then, at the sources of this mystery, and we shall find them all resolving themselves into this one fact,—The infinite transcendency of the Divine perfections.

The wise and good among men frequently act on principles which are not obvious to their inferiors, who are not capable of entering into their exalted views. Can it be matter of surprise, then, that the feeble and grovelling race of Adam should be found incapable of entering into the councils of Him who is infinitely wise, and infinitely good? As in His own nature He is incomprehensible, so in the operations of His providence He may be, and, indeed, He frequently must be, influenced by motives far above our conception. "As the heavens are higher than the earth, so are His ways higher than our ways, and His thoughts than our thoughts." He acts from the

infinite, eternal, and unchangeable impulse of His own mind. The highest angels are infinitely beneath Him. Even they cannot fathom the depth of His councils. No wonder, then, that we should often be confounded in our attempts to scan His character, and comprehend His views.

We shall be better able to understand the extent of the difficulty, if we enter into particulars, and consider some of the ways in which the providence of God operates on His rational creatures. God is omniscient. He knows our frame, and "understands our ways afar off." He forms no superficial or unjust judgment of our character and motives, as we short-sighted mortals do in regard to our fellow men. He knows, for instance, whether our actions proceed from selfish or benevolent motives; whether a sense of duty or a love of human approbation lies at the bottom of our conduct;—whether worldly possessions improve or corrupt our hearts. He, therefore, knows, what we cannot distinctly know,—the kind of discipline we require to train us for heaven; and He accommodates the operations of His providence to this knowledge. He comforts us with hope, or encourages us with success, or blesses us with enjoyment, and causes His "candle to shine on our head," just to the extent to which He sees these earthly blessings will be really useful to us. And, on the other hand, He mortifies us with disappointment, or humbles us with disgrace, or chastens us with poverty, or warns us by sickness, or causes the loss of all that was nearest and dearest to our hearts,—that He may thus call us to serious reflection, and break the ties which bind us to the earth, and lead us to place our treasure, and fix our affections, in heaven. And all this He frequently does, without our being able to understand His reasons, because we are ignorant both of our own character and wants, and of the character and wants of others.

Nor is this all. God is acquainted with the ultimate consequences of all events. He traces every thing to its

most remote effects. It is not merely the advantage of a day, or a month, or a year, that He regards. He looks forward to the most distant futurity, and, with unerring certainty, calculates the precise bearing of every present event on ages yet to come. It is an awful consideration, that there is not an action of our lives, nor a word which we utter, nor even a thought which passes through our hearts, that may not be pregnant with important consequences,—with consequences which may not only deeply affect ourselves, but others; which may be productive of good or evil, not merely in our own immediate circle, but, sometimes, even to the community among whom we dwell, and the age in which we live. Nor does the influence necessarily stop here,—it may extend to distant posterity. These consequences *we* cannot see, but God estimates them all. Every word, every look of ours, the all-seeing Eye follows through all its effects on the character of our children, and friends, and neighbours; and thence, again, on the sentiments and conduct of others influenced by them; and, further still, on those of their children, and their children's children, to the latest generations. How infinitely is this beyond the grasp of the human mind!

Again, the Eternal not only knows the effects, but the relations and comparative value of all things. Men view events under a perverted aspect,—judging of their importance more by their nearness or their distance, than by their intrinsic worth. Through the false medium of passion or of prejudice, we are apt to magnify or contract the dimensions of objects, and to form an opinion of them altogether different from the reality. We shall be more sensible of this, if we reflect, for a moment, on the different sentiments with which we regard death, when we hope that this event is distant, and when we perceive or imagine it to be near; or, indeed, if we consider the general tendency of the mind to form a foolish attachment to temporal things, in preference to those things that are eternal.

But none of these prejudices and prepossessions obstruct or deceive the vision of the Almighty. Those things which occupy the attention of our worldly minds, He sees in all their emptiness and frivolity; the heavenly treasures which we regard with such indifference, He views in their infinite magnitude and importance; and all these, with unerring wisdom, He adjusts (independent of the vain wishes of men), so as to promote the greatest good. Here is another obvious source of inadequate comprehension on our part.

We must further remember, that these unsearchable operations are not confined to the welfare of individuals. They embrace the interests of nations,—of the earth,—of the universe! While there is not a living being in creation to whom the paternal care of the Creator does not extend, He views the world as a whole, and so regulates every part, as either to promote the happiness of all, or to visit them with retributive justice. What a wonderful conception is this! From the worm to man, from man to the archangel, all are linked together in the councils of God; and, while there is not one of all these creatures whom He does not care for, as if there were no other being to occupy his attention, all are governed as one great family, of which each member has its own department, and in which one great design is constantly kept in view,—the perfection and happiness of the whole.

Nor must we forget, that the schemes of the Self-existent are not bounded by time, but embrace eternity. In the present world, the moral government of God is only begun. That may appear imperfect and disordered, of which we only see a part, when, if the whole were displayed and understood, every minute particular, and the united result of the whole, would be found to be the perfection of wisdom.

He who has seen a powerful and complicated system of machinery in operation, of which he was only permitted to examine a small part, may form some idea of

the effect of so partial a view of the operations of Providence. He saw an apparently confused and unwieldy mechanism, of which he neither understood the principle nor the use. Wheels on wheels, moving in seeming disorder,—valves opening and shutting,—levers straining,—beams revolving,—while fire and water combined their mysterious powers. He perceived, in short, an immense expense of labour and ingenuity,—and all for what? He could not tell: He observed amazing powers in operation; he heard a grating and astounding noise,—and that was all. But were he admitted into the upper apartments, where the effect of all these operations is displayed, what a different opinion would he form? How would he admire the talents which could so control the powers of nature, as to give man a force immensely superior to his own, and add to the resources, and ensure the prosperity, not of individuals only, but of the whole empire!

And so it is with the operations of Providence. Here we see but a part, and that a very small part, of the machinery by which He conducts the moral government of the world. Even if we could understand all the relations of temporal things, we could not understand their bearings on eternity. Some glimpses, indeed, Revelation has afforded us into that upper apartment, where the whole scheme is consummated, and where the ways of God are vindicated to his creatures; but how imperfect and how inadequate! Let us look forward with eagerness and hope to the approaching period, when the veil shall be removed from our eyes, and "we shall see even as we are seen."

TWELFTH WEEK—MONDAY.

IV. FROST.—EFFECTS OF IT IN THE NORTHERN REGIONS.

In passing from our own temperate climate, to higher latitudes, the rigours of winter are exhibited in a more unmitigated form, and the injurious effects of cold become more apparent. A slight sketch of the state of these regions, in relation to the phenomena of frost, may not be uninteresting.

Many of our readers are rendered familiar with the appearances of nature in the northern regions, by a perusal of the writings of our modern voyagers. From these some facts have elsewhere been selected, relative to the state of the vegetable and animal worlds, in the countries they visited; but, in the description of the effects of frost in that dreary climate, I prefer having recourse to an author less generally known, I allude to Captain Middleton, who gives a graphic and minute account of the effects of cold in the neighbourhood of Hudson's Bay, during winter, which is applicable, with additional rigour, to the state of places still nearer the pole, where a dreary uniformity reigns. I shall abridge this narrative, so as to afford a condensed view of the subject, in its most striking features.

The ground is frozen, even in summer, to the greatest depth which was penetrated, which, however, was not more than ten or twelve feet. No unfrozen spring of water could be found; and the lakes and rivers became, in winter, one solid cake of ice, fixed to the ground, when they did not exceed the depth of twelve feet. In large lakes and rivers, the ice was sometimes broken by "imprisoned vapours," and the rocks and trees, and even the joists and rafters of their buildings were not unfrequently burst with a noise as loud as the firing of a broadside by a man-of-war. If beer or water was left

by the bedside, in cans, or bottles, or even in copper pots, in a severe night, they were sure to be split in pieces, before morning, by the expansive power of the ice in freezing. The air was filled with innumerable particles of ice, very sharp and angular, and plainly perceptible to the naked eye. All inland waters were frozen fast by the beginning of October, and continued so till the beginning of May. *Coronæ and parhelia*, that is, halos and mock suns, were very frequently observed. The aurora borealis was seen almost nightly. It shone with a surprising brightness, darkening all the stars and planets, and covering the whole hemisphere with a beautiful tremulous lustre. Seaward, the immense icebergs which crowded the scene, added greatly to the interest of the prospect. Some of these immense aggregations of ice are said to have been immersed a hundred fathoms* below the water, while they towered nearly a hundred feet above its surface, and extended in circumference to three or four miles.

The following amusing account is given of the clothing with which Captain Middleton, and his companions, defended themselves from the intense cold:—"For our winter dress, we make use of three pairs of socks, of coarse blanketing or frieze, for the feet, with a pair of deer-skin shoes over them; two pairs of thick English stockings, and a pair of cloth stockings upon them; breeches lined with flannel; two or three English jackets, and a fur or leathern gown over them; a large beaver cap, double, to come over the face and shoulders; and a cloth of blanketing over the chin; with yarn-gloves, and a large pair of beaver-mittens, hanging down from the shoulders before, to put our hands in, which reach up as high as our elbows."

I shall conclude this description of the rigours of a northern climate, with the deeply interesting account given of a *ground-swell* in the ice, on the northern coast of Labrador, in Dr Brown's "History of the Propagation

* This is probably an exaggeration.

of Christianity." A party of Moravian missionaries were engaged in passing across an arm of the sea, on sledges drawn by dogs. The first alarm was given by some passing Esquimaux, and afterward by their own attendants; but the approach of danger was at first scarcely perceptible, except on lying down, and applying the ear close to the ice, when a hollow grating noise was heard ascending from the abyss. By-and-by the wind rose to a storm, and the swell had increased so much, that its effects on the ice were extraordinary, and really alarming. "The sledges instead of gliding smoothly along, as on an even surface, sometimes ran with violence after the dogs, and sometimes seemed with difficulty to ascend a rising hill. Noises, too, were now distinctly heard, in many directions, like the report of cannon, from the bursting of the ice at a distance. Alarmed by these frightful phenomena, our travellers drove with all haste toward the shore; and, as they approached it, the prospect before them was tremendous. The ice, having burst loose from the rocks, was tossed to and fro, and broken in a thousand pieces against the precipices, with a dreadful noise; which, added to the raging of the sea, the roaring of the wind, and the driving of the snow, so completely overpowered them, as almost to deprive them of the use both of their eyes and ears. To make the land was now the only resource that remained; but it was with the utmost difficulty that the frightened dogs could be driven forward; and, as the whole body of the ice frequently sank below the summits of the rocks, and then rose above them, the only time for landing was the moment it gained the level of the coast—a circumstance which rendered the attempt extremely nice and hazardous. Both sledges, however, succeeded in gaining the shore, though not without great difficulty. Scarcely had they reached it, when that part of the ice from which they had just escaped, burst asunder, and the water, rushing up from beneath, instantly precipitated it into the ocean. In a moment, as if by a signal, the whole

mass of ice, for several miles along the coast, and extending as far as the eye could reach, began to break and to be overwhelmed by the waves. The spectacle was awfully grand. The immense fields of ice, rising out of the ocean, clashing against one another, and then plunging into the deep with a violence which no language can describe, and a noise like the discharge of a thousand cannon, was a sight which must have struck the most unreflecting mind with solemn awe. The brethren were overwhelmed with amazement at their miraculous escape; and even the pagan Esquimaux expressed gratitude to God for their deliverance."*

TWELFTH WEEK—TUESDAY.

FROST.—ITS AGENCY IN MOUNTAINOUS REGIONS.

I HAVE already mentioned, that water suddenly expands in the process of freezing; now, the force with which the expansion takes place is immense, as has been proved by various experiments. The barrel of a gun, and even the body of the strongest cannon, when filled to the muzzle with water, and tightly screwed up, have been found to burst under this process in a hard frost; and, indeed, there does not appear to be any known power in the material world strong enough to resist it. This property seems to be one of the most active agents in breaking down rocks and diminishing the height of mountain ranges, particularly in regions distant from the equator. The water which penetrates the fissures of the rocks during the early part of the winter, is converted into ice, and, by the sudden expansion which then takes place, rends the solid rocks asunder, with a noise which is heard at the distance of many miles; and, where the

* Brown's History of the Propagation of Christianity among the Heathen, vol. ii. p. 51.

surface happens to be precipitous, and the equilibrium is destroyed, the detached masses, on the melting of the ice, by the return of spring, fall over with a tremendous crash, and, in the fearful avalanche, sometimes overwhelm whole villages and fields, carrying sudden and inevitable destruction to their inhabitants. Most distressing occurrences from this cause take place every year in those lofty and rugged districts where nature has formed so strong a barrier against the encroachments of hostile armies, and where freedom so long maintained her throne, and religion her purity and independence, in the midst of enslaved and degraded kingdoms. In the narrow valleys of the Swiss Cantons, and along the ravines formed by those tributary streams which supply the ample currents of the Rhine and the Rhone, winter has terrors altogether unknown to the inhabitants of less Alpine territories. Sometimes an avalanche blocks up the channel between two mountains, till the accumulated waters of weeks or months force for themselves a passage, and, rushing forward with a tremendous flood, carry far-spread inundation and death over the smiling and well-peopled valleys below. In other places, year after year, on the breaking up of the winter storms, rocks and stones rolling down the sides of the mountains, gradually but surely, overwhelm whole districts, which the industry of man had rendered fertile, and cause them to be abandoned to the eagle, the marmot, and the chamois. These encroachments are fearful, while others, of a description scarcely less formidable, occur in different situations of the same interesting ranges. Not unfrequently, the majestic glacier, undermined by some mountain stream, or rendered unstable by the accumulating snows and frosts of ages, gives way in an instant, and, toppling over from its giddy height, tumbles headlong to the lower grounds; not only bearing extensive destruction in its fall, but chilling, for many years, the climate of all the surrounding district with its wintry breath.

Such calamitous events remind us, that we live in a world, among the conditions of which are desolation and suffering; and they carry our thoughts upward to that happy land where there is no death, no calamity, no change,—where trials are past, and tears are wiped away; and where the dark valley, and the narrow path, have ended in a boundless and glowing paradise of eternal sunshine and unfading bloom.

In one point of view, the events I have adverted to, are of importance in the controversy with the atheist, who dreams of the eternity of matter, and an eternal succession of uncreated beings. The process of decay which is so actively going on in our mountain ranges, is an undeniable proof of the comparatively recent formation of these rugged elevations, and, by a necessary consequence, of the present surface of the globe, of which they form so extensive and so essential a feature. It is impossible that they could have existed from eternity, or even for any period to which the power of calculation cannot easily extend. Had the earth endured without disruption for a million of years, for example, long ere now the power of frost, and other causes of decay, would have crumbled to dust the hardest projecting rocks, levelled the highest mountains, and reduced the whole surface of the globe to a marshy and unwholesome plain. Our world has neither existed from eternity, nor is it formed for eternal existence. While the frost rends asunder matter subjected to its influence, the air decomposes it, the storm scatters it, the rain washes it away, rivers and overwhelming torrents carry it to the valleys and the ocean; the formation of downs, the fall of forests, and the decay of vegetation, are continually altering the relative depth of the low grounds by their accumulations. "Ages on ages might indeed pass away before these agents could produce their extreme effects, yet that their action is neither inconsiderable nor very slow, innumerable observations have rendered incontestable."*

* Bushnan's Study of Nature.

Now, long before the earth had arrived at the point to which it is so evidently tending, the fall of the mountains would render it a comfortless and noxious habitation. Our springs and rivers would be absorbed and disappear in fetid swamps; the winds and rains, on which mountainous districts produce such salutary effects, would cease to be equably dispersed; in one extensive region, the stagnant atmosphere, loaded with poisonous vapours, would spread pestilence and death; and in another, winds, blowing continually and violently from one point of the compass, would shed a blight over both the vegetable and animal world. The wide spread and desolate Steppes of Russia, in short, where nothing is seen on every side but a cheerless and level waste, and where, from horizon to horizon, a death-like silence reigns, would be but a faint picture of the miserable scene, which a decayed world would present to its last sickly and dying inhabitants.

But the earth is not destined to arrive at this state of feeble and decrepit age. Thousands of centuries before that period would arrive, its task will be accomplished, and its race run; for the irreversible decree of the Creator is, that at no distant period, "The heavens being on fire shall be dissolved, and the elements shall melt with fervent heat; the earth also, and the works that are therein, shall be burnt up." Yet how cheering is the promise with which that decree is accompanied,—that there shall be the creation or development of "New heavens, and a new earth, wherein dwelleth righteousness;" and how appropriate is the exhortation of the apostle, "Wherefore, beloved, seeing that ye look for such things, be diligent, that ye may be found of Him in peace, without spot and blameless."*

* 2 Peter, chap. iii.

TWELFTH WEEK—WEDNESDAY.

VI. HOAR-FROST.—FOLIATIONS ON WINDOW-GLASS.

There are some beautiful appearances which frost frequently assumes, to cheer us, as it were, and give an agreeable exercise to our taste, in the absence of that loveliness, which the hand of an indulgent Creator sheds so profusely over our fields and gardens, in the genial months of spring and summer. I have already noticed the fantastic forms which ice assumes at a waterfall, and the pleasure which arises in the mind, on contemplating the loaded woods, and the undulating surface of the earth, after a fall of snow. Nature is almost always either grand or elegant; and, when it is otherwise, the very contrast is a source of enjoyment. In other words, the mind is so constituted as to derive pleasure from all the aspects of the external world. But there are some things better adapted than others to afford gratification to the taste; and, when I mention hoar-frost, a thousand agreeable recollections will arise in every mind. This appearance is occasioned by the freezing of the mist or dew,* and seems to be the result of a process similar to that by which snow is formed in the higher regions of the atmosphere. There is this difference, however, that the snow is formed from the rain-drops or humid clouds suspended in the air, without any solid nucleus to which they can adhere; while the hoar-frost is usually elabo-

* The phenomena of dew, and of hoar-frost, when it arises from dew, are owing to the radiation of caloric from the surface of the earth, without any interchange from the sky. "The caloric radiated during the night," says Mrs Somerville, "by substances on the surface of the earth, into a clear expanse of sky, is lost, and no return is made from the blue vault, so that their temperature sinks below that of the air, whence they abstract a part of that caloric which holds the atmospheric humidity in solution, and a deposition of dew takes place. If the radiation be great, the dew is frozen, and becomes hoar-frost, which is the ice of dew."

rated on the blades of grass, or branches of trees, or other substances with which the moist particles come in contact. It is a well known law, that water does not readily freeze, unless it have some solid substance on which it can form. It is on this account that, in a pond or lake, we always see the first appearance of ice either along its margin, or shooting out in long beautiful feathers from some random stick or stone projecting on its smooth surface. In obedience to the same law, the watery particles floating in the air, after being exhaled from the surface of the earth, although they are at, or even below, the freezing point, retain their fluid state when the frost is not very intense, till they meet with something solid, when they instantly become crystallized, and are deposited on the trees, the hedges, and the spreading meadows, in those elegant forms which so far excel the frost-work of art. This happens frequently in an atmosphere entirely clear; and indeed a cloudless sky is essential to that rapid evaporation from the earth's surface, which gives rise to an abundant dew; but we often observe the hoar-frost also produced by a dense haze, which broods over the surface of the low grounds, during the night, in the form of a sluggish cloud, and which is dissipated by the first rays of the rising sun. In this latter case, the snowy incrustation is thicker and more general, and the effect is like enchantment. The scene which, at nightfall on the preceding evening, was bleak and cheerless, is all at once converted into fairy land. Every vegetable substance, from the blades of grass which lay drooping in the naked fields, to the sere leaves and gnarled branches of the lofty forest oak, is suddenly clothed with a garniture of purest down, whose beauty surpasses the poet's dream, and is scarcely less substantial or less fleeting.

Another most beautiful effect of frost, which, however, is only rarely observed in this climate, where the alternation from comparative warmth to intense cold is not so sudden as in some other countries, is finely described

in the following well known passage of a poetical letter from Copenhagen, by Mr Phillips:—

"Ere yet the clouds let fall the treasured snow,
Or winds began through hazy skies to blow,
At evening, a keen eastern breeze arose,
And the descending rain, unsullied, froze.
Soon as the silent shades of night withdrew,
The ruddy morn disclosed at once to view
The face of Nature in a rich disguise,
And brightened every object to my eyes:
For every shrub, and every blade of grass,
And every pointed thorn, seemed wrought in glass;
In pearls and rubies rich the hawthorns show,
While through the ice the crimson berries glow;
The thick-sprung reeds, which watery marshes yield,
Seem polished lances in a hostile field.
The stag, in limpid currents, with surprise,
Sees crystal branches on his forehead rise.
The spreading oak, the beech, and towering pine,
Glazed over, in the freezing ether shine.
The frighted birds the rattling branches shun,
That wave and glitter in the distant sun.
When, if a sudden gust of wind arise,
The brittle forest into atoms flies;
The cracking wood beneath the tempest bends,
And in a spangled shower the prospect ends."

Nor must I omit to mention yet another pleasing production of frost, in the elegant and varied foliations which are formed on the glass of windows. This appearance takes place most remarkably in cases where the air within the room happens to have been much impregnated with moisture, either from the human breath, when several individuals have been collected, or from any other cause. The coldness of the glass causes the floating vapour to be condensed on its surface, where it shoots out, as it freezes, into those flowery crystals, which excite our admiration. The precise cause of this phenomenon may be obscure, like every other pheno-

menon of congelation; but the effect is at once curious and pleasing; while, if we trace it up to that law, of which it is only an example, it will acquire a higher importance, and be found to be connected with a principle of vast magnitude in the world of unorganized matter; for the crystallizing process (and freezing is nothing else), seems to form the link between unorganic and organic substances; by the regular structure of its productions, mysteriously uniting crude matter with the vegetable and animal creations.

The pious Sturm, in speaking of this phenomenon, views it in a light different, indeed, but not less important, while his reflection equally applies to the other appearances of frost, which we have been examining. "Can an object be considered as little," says he, "when it furnishes matter for useful reflection? For my own part, I do not disdain to read, even on the frozen glass, a truth which may have a great influence on my happiness. Behold the flowers which the frost has portrayed on the glass! They are beautifully and artificially varied; nevertheless, one ray of the noonday sun effaces them. Thus the imagination paints every thing beautiful to us; but every thing which it represents as attractive in the possession of the goods of this world, is but a beautiful image which shall disappear in the light of reason. The importance of this lesson of wisdom was worth the trouble of stopping for a while, at the little phenomenon which furnishes it."

TWELFTH WEEK—THURSDAY.

VII. FROST.—BENEFICENT CONTRIVANCES RELATIVE TO SNOW.

As the influence of cold is felt in the air, as well as on the surface of the earth, and indeed becomes more intense, in proportion to the elevation, it must affect the

moisture which floats in the atmosphere. The rain-drops must freeze, and, when frozen, must be precipitated to the ground. Now, were this process to take place in the same manner as it occurs on the face of a lake or pond, and were the water in the clouds to be converted into solid lumps of ice, the most unhappy consequences would ensue, as may be inferred from the damage occasioned by a hail-storm,—an occurrence which sometimes but rarely happens, as if to call our attention to the beneficent provision by which this calamity is usually obviated. The fruits of the earth would be destroyed; or, if the season of fruits was past, at least the branches and embryo buds of plants and trees would be shattered; birds on the wing, or on the perch, would be struck to the ground, stunned and dying; the more tender quadrupeds would receive their death-blow; and even the hardy races of animals, and man himself, would not escape material injury. None of these consequences, however, actually take place, because the frozen rain-drops descend, not in the form of ice, or even usually in the less destructive form of hail, but on the downy wings of virgin snow.

Let us consider, then, the properties of snow, and we shall not fail to admire the wisdom of the provision. The vapour floating in the atmosphere is arrested by the cold, and is frozen; but, instead of running together, as might be expected, into solid masses, it unites with the nitrous particles, also to be found mingled with the air, and, forming a compound crystal, shoots out into beautiful feathery flakes. Whoever will take the trouble to examine one of these flakes with the aid of a microscope, cannot fail to admire the elegance and skill of its structure. He will observe many little sparkling crosses or darts radiating from a point, and branching off and meeting in all directions, so as to form hexagonal lines of much beauty, wrought apparently with the nicest art, and wonderfully fitted for passing, with a kind of buoyant and flickering motion, through the air, so as to drop,

without disturbance, on the ground, spreading, as they actually do, a coat of dazzling whiteness, profusely, but gently, over bush and brake, lawn and mountain. It has been found by experiment, that "snow is twenty-four times lighter than water, and that it fills up ten or twelve times more space, at the moment of falling, than the water produced from it when melted."* This is an admirable contrivance, to prevent, or at least to modify, what would otherwise prove a great evil.

Another useful property of snow has been noticed by many writers, and is verified by yearly experience. Being a very imperfect conductor of heat, it does not readily descend below the freezing point, and thus tempers the rigour of the season. Under its white covering, the earth remains of a moderate and equal temperature, and the bulbs and roots of plants are preserved from the ungenial influence of a severe sky. In consequence of the same slowness in the conduction of heat, the Arctic traveller can sleep, without much inconvenience, on his bed of snow, which is warm compared with the atmosphere he breathes; and, for the same reason, the snow-formed hut affords the Esquimaux no unpleasant abode.†

Nor must we forget to remark, with reference to the effects of snow on the soil, that the nitrous particles which it contains, are said to be of a fertilizing quality, and, as it gradually melts, these particles penetrate the earth, being carried to the roots of the plants, mingled with the water into which it is converted. Assuming the accuracy of this latter observation, we shall find abundant cause for admiring an arrangement, which, in various ways, converts an apparent curse into a blessing, changing that which seems to be an aggravation of this inclement season, and a source of sterility, into a protection from the cold, and a means of future fruitfulness.

But there is yet another arrangement, in reference to

* Sturm's Reflections, January 26.

† Whewell's Bridgewater Treatise, p. 90.

this subject, which must not be overlooked. When the weather changes, which it sometimes does very suddenly, the greatest inconveniences, and even calamities, would ensue, were the effect of this change to operate, as might, without experience, be expected, in producing an instantaneous conversion of the snow into water. If the frost were as quickly expelled from water as from the air, the moment that the temperature rose above 32°, the snow would become liquid as by magic, the ice would vanish like a dream from river and lake, and the rigid earth would, on the higher grounds, be in an instant converted into a swamp, and in the valleys would be overflowed, and swept away by mountain torrents. A very peculiar and remarkable property prevents these disastrous effects. In the act of dissolving, the water absorbs a quantity of heat, and retains it in a *latent* state; and, on this account, the melting process cannot take place till a sufficient quantity has been absorbed. This necessarily causes the process to be slow; and days, and even weeks, may pass away, after the thaw has begun, before the ice entirely disappears from our ponds, or the snow from our hills. The advantageous consequences of this retardation, are too obvious to require further illustration; but it is of consequence to remark, that it is effected, not as a result of an ordinary and general law, but rather by what has been justly called the apparent *violation* of a law. A sudden stand, as it were, is made in the progress of the change. The alteration of temperature, instead of producing its ordinary effects, becomes, all at once, apparently feeble and languid in its operations; the heat, as it is applied, disappears, and its dissolving power is restrained within such bounds, as to render the process comparatively innoxious.

A similar effect is produced in the *boiling* of water. At the boiling point, as well as at the thawing point, a sudden stoppage takes place, and the heat applied becomes *latent*, so as to preserve the water at that point, till it is gradually carried off in the form of steam. It

is this property which renders water so useful in the various operations of the kitchen and the manufactory. If the whole volume of the water we employ were to be instantly converted into steam, when it arrived at the boiling point, which would certainly be the case, were it not for the peculiar property of which we are speaking, how much would be detracted from the usefulness of this most useful element!

Here, then, we have a wonderful modification of a general law, the beneficial nature of which is as manifest as the property itself is remarkable. Can we do otherwise than attribute it to the contrivance of an intelligent Creator?

The striking appearance of a landscape covered with new-fallen snow, and the effects produced on the lower animals by its fall, are thus graphically described by the poet of the Seasons:—

"The cherished fields
Put on their winter robe of purest white.
'Tis brightness all; save where the new snow melts
Along the mazy current. Low the woods
Bow their hoar heads; and, ere the languid sun,
Faint from the west, emits his evening ray,
Earth's universal face, deep hid and chill
Is one wild-dazzling waste, that buries wide
The works of man. Drooping, the labourer-ox
Stands covered o'er with snow, and then demands
The fruit of all his toils. The fowls of heaven,
Tamed by the cruel season, crowd around
The winnowing store, and claim the little boon
Which Providence assigns them. One alone,
The red-breast, sacred to the household gods,
Wisely regardful of the embroiling sky,
In joyless fields and thorny thickets, leaves
His shivering mates, and pays to trusted man
His annual visit. Half afraid, he first
Against the window beats; then brisk alights
On the warm hearth; then, hopping o'er the floor,
Eyes all the smiling family askance,

And picks, and starts, and wonders where he is;
Till, more familiar grown, the table crumbs
Attract his slender feet. The foodless wilds
Pour forth their brown inhabitants. The hare,
Though timorous of heart, and hard beset
By death in various forms,—dark snares, and dogs,
And more unpitying men,—the garden seeks,
Urged on by fearless want. The bleating kind
Eye the bleak heaven, and next the glistening earth,
With looks of dumb despair; then, sad, dispersed,
Dig for the withered herb through heaps of snow."

TWELFTH WEEK—FRIDAY.

SAGACITY AND FIDELITY OF THE DOG IN SNOW.

I WELL remember with what delight I listened to an interesting conversation, which, while yet a schoolboy, I enjoyed an opportunity of hearing in my father's manse, between the poet Burns, and another poet, my near relation, the amiable Blacklock. The subject was the fidelity of the dog. Burns took up the question with all the ardour and kindly feeling with which the conversation of that extraordinary man was so remarkably embued. It was a subject well suited to call forth his powers, and, when handled by such a man, not less suited to interest the youthful fancy. The anecdotes by which it was illustrated, have long escaped my memory; but there was one sentiment expressed by Burns, with his own characteristic enthusiasm, which, as it threw a new light into my mind, I shall never forget. "Man," said he, "is the god of the dog. He knows no other, he can understand no other:—And see how he worships him! With what reverence he crouches at his feet, with what love he fawns upon him, with what dependance he looks up to him, and with what cheerful alacrity he obeys him! His whole soul is wrapped up in

his god; all the powers and faculties of his nature are devoted to his service; and these powers and faculties are ennobled by the intercourse. Divines tell us that it ought just to be so with the Christian; but the dog puts the Christian to shame."

The truth of these remarks, which forcibly struck me at the time, have since been verified by experience; and often have events occurred which, while they reminded me that "man is the god of the dog," have forced from me the humiliating confession, that "the dog puts the Christian to shame."

The dog was certainly created to be a companion and assistant to the human race. It is well observed by Goldsmith, that the generality of animals have greater agility, greater swiftness, and more formidable arms, from Nature, than man; their senses, and particularly that of smelling, are often far more perfect. This is the case with the dog; the having gained, therefore, a new assistant, in this sagacious and quick-scented animal, was the gaining of new powers, of which man stood in need. There are various important services rendered to man by the dog, which may be more properly noticed afterward. At present, I shall confine myself to a few instances, in which he contributes, by his docility, his sagacity, and his attachment, to lessen the dangers of the winter storm, or to mitigate, by his useful labours, the rigours of an ungenial climate.

I begin by abridging Captain Parry's account of the manner in which dogs are employed by the Esquimaux, in conveying them from place to place in sledges over the ice or frozen snow;—premising that dogs of this species are somewhat smaller in size than those of Newfoundland, and bear a strong resemblance to the wolf of that country, and that they have very firm bone in their fore-legs, with great strength in their loins, two essential qualities for the purposes of draught. When drawing a sledge, the dogs have a simple harness of deer or seal-skin going round the neck by one bight or loop, and an-

other for each of the fore-legs, with a single thong leading over the back, and attached to the sledge as a trace. Though they appear at first sight to be huddled together without regard to regularity, there is, in fact, considerable attention paid to their arrangement, particularly in the selection of a dog of peculiar spirit and sagacity, who is allowed, by a longer trace, to precede the rest as a leader, and to whom, in turning to the right or left, the driver usually addresses himself. This choice is made without regard to age or sex, and the rest of the dogs take precedency according to their training or sagacity, the least effective being placed nearest the sledge. The leader is usually from eighteen to twenty feet from the forepart of the sledge, and the hindmost dog about half that distance; so that, when ten or twelve are running together, several are nearly abreast of each other. The driver sits quite low, on the forepart of the sledge, with his feet overhanging the snow on one side, and having in his hand a whip, of which the handle is eighteen inches, and the lash more than as many feet in length. The men acquire from their youth considerable expertness in the use of the whip, the lash of which is left to trail along the ground by the side of the sledge, and with which they can inflict a very severe blow on any dog at pleasure. The dogs are kept in training entirely by the fear of the whip; but in directing the sledge it acts no very essential part, the driver for this purpose using certain words, as waggoners do with us, to make the dogs turn to the right or left. To these a good leader attends with admirable precision, especially if his own name be repeated, at the same time looking behind over his shoulder with great earnestness, as if listening to the directions of the driver. With "good sleighing," that is, on good roads, six or seven dogs will draw from eight to ten hundred weight, at the rate of seven or eight miles an hour, for several hours together. With a smaller load they will run ten miles an hour, and are, in fact, almost unmanageable. To the women, who nurse them

when ill, and treat them with greater kindness than the men, they are affectionate in the highest degree. From the men they receive little except blows and rough treatment;—still they are faithful and enduring.

Another dog, of a kind not dissimilar to that of the Esquimaux, performs to man in a different region a service of a different kind, for which still greater sagacity is necessary. I allude to the Alpine spaniel, which is employed by the monks of the convent of the great St Bernard, on their errands of humanity. This convent is situated near the top of that high mountain, not far from the region of perpetual snow, where the traveller is often suddenly overtaken with the most severe weather, and is liable to a thousand accidents. The sun becomes suddenly darkened; the wind howls; the snow comes in swirls through the air, and drifts up his path; the fatal avalanche falls from the impending cliff, and sweeps trees and rocks into the valley, along with the helpless passengers, or buries them deep beneath its thundering mass. The pious and generous monks devote themselves in this region horrors to offices of humanity; and in their truly Christian task they are admirably assisted by a noble breed of dogs, whom they have trained, and keep in their establishment, for the purpose of rescuing travellers from destruction. Benumbed with cold, weary in the search of a lost track, his senses yielding to the stupifying influence of frost, which betrays the exhausted sufferer into a deep sleep, the unhappy man sinks upon the ground, and the snow drift covers him from human sight. It is then that the keen scent and the exquisite docility of these admirable dogs are called into action. Though the perishing man lie ten, or even twenty feet below the snow, the delicacy of smell with which they can trace him, offers a chance of escape. They scratch away the snow with their feet, and they set up a continued hoarse and solemn bark, which brings the monks and labourers to their assistance. To provide for the chance, that, without human help, the dogs may succeed

in discovering the unfortunate traveller, one of them has a flask of spirits round his neck, to which the fainting man may apply for support, and another carries, strapped on his back, a cloak to cover him. These wonderful exertions are often successful. One of these noble creatures was decorated with a medal, in commemoration of his having saved the lives of twenty-two persons, who but for his sagacity must have perished. He himself, however, met an untimely fate in 1816, in an attempt to convey a poor Piedmontese courier to his anxious family. The traveller, with two guides and this remarkable animal, were descending the mountain, and some members of his family were toiling upward in search of him, when two avalanches overwhelmed them all in one common destruction.*

The shepherd's dog of Britain is not less susceptible of training than the Alpine spaniel, and its affection for its master often wonderfully supplies the place of teaching, and inspires it with a wisdom little short of human. Instances in illustration of this are familiar to the inhabitants of mountainous districts, and the following examples, related by Captain Brown, cannot fail to interest the reader :—

" A farmer, near Brechin, having gone, during a severe snow-storm in 1798, to visit his sheep, while employed in driving them from the shelter which they had taken beneath some precipitous rocks, called Ugly-Face, was, with his dog, buried in an avalanche of snow, which fell from these rocks. He was unable to extricate himself, and fell asleep in his desolate situation ; but his dog worked his way out, ran to his house, and by significant gestures, procured the assistance of some of the inmates, who, following the dog, were led to the spot where he was overwhelmed with snow. They began to dig, and by nightfall found the farmer in an erect position, quite

* Captain Brown's note to Goldsmith's " Animated Nature," vol. ii. p. 207.

benumbed, but life not extinguished, and being rolled in warm blankets, he soon recovered.

"About the year 1796, a farmer, at Holling, in Kent, was returning late from Maidstone market, in a state of intoxication. He went astray from the road, about half a mile from Willow-Walk, and becoming completely benumbed, he fell among the snow, in one of the coldest nights ever known. Turning on his back, he was soon overpowered with sleep, in such circumstances the usual concomitant of cold. His dog, that had followed closely after him, now scratched away the snow from about him, so as to form a protecting wall round his person, and then lay down on his master's breast, for which its shaggy coat proved a seasonable protection from the inclemency of the night, and the snow which continued to fall. On the following morning, a person having gone out with the expectation of falling in with some wild fowl, had his notice attracted by the uncommon appearance, and, on coming up, the dog encouraged him, by the most significant gestures, to approach. He wiped the icy incrustations from the face of the farmer, whom he then recognized, and had him conveyed to the nearest house in the village, where animation was soon restored."

The last instance which I give of this kind of sagacity, is abridged from Captain Brown's Statement, and shows still more remarkable proofs of persevering attachment. Eric Runtson, an Iceland fisherman, left his home early on a December morning, to visit a friend, accompanied only by his faithful dog, Castor. When he had proceeded about five miles, he fell into a deep chasm, and alighted, unhurt, on a shelving part of the rock, about sixty feet below the surface. Castor ran about in all directions, howling piteously. He even several times made as if he would leap down, but was prevented by his master scolding him. He then whined, and looked from the brink into the chasm, as if anxious to receive his master's commands. After spending the whole day in fruitless endeavours to reach and extricate his master, a sudden

thought seem to seize him, and he darted off in the direction of home, which he reached about eleven o'clock. The inmates were asleep, but, by scratching violently at the door, he gained admittance. At first, the family apprehended nothing, but that he had left his master, and returned; but, by his refusing food, and constantly continuing to scratch Eric's younger brother, Jon, with his paw, and then to run to the door, and look back with eager and anxious yells, he at last succeeded in exciting their alarm; and, when Jon and another man dressed and followed him, he began to bark and caper about with evident joy. At one time, the tempestuous weather led them to think of retracing their steps; but Castor, on their turning back, expressed the utmost dissatisfaction, and, by pulling them by the clothes, induced them to proceed. He conducted them to the chasm where poor Eric was entombed, and, beginning to scratch, signified, by the most expressive howl, that his master was below. Eric answered to Jon's call; and, a rope being procured, he was safely drawn up, when Castor rushed to his master, and received his caresses with all the marks of extreme triumph and joy.

Sir Walter Scott, in a poem written on a traveller who, some years ago, was killed by falling over a precipice on Helvellyn, and whose faithful dog watched many days by his lifeless corpse, thus feelingly describes the attachment of that interesting animal:—

"Dark green was that spot 'mid the brown mountain heather,
Where the pilgrim of Nature lay stretched in decay,
Like the corpse of an outcast abandoned to weather,
Till the mountain winds wasted the tenantless clay:—
Nor yet quite deserted, though lonely extended,
For faithful in death his dumb favourite attended,
The much-loved remains of her master defended,
And chased the hill-fox and the raven away.

How long did'st thou think that his silence was slumber?
When the wind waved his garments how oft did'st thou start?

How many long days and long nights did'st thou number?
Ere he faded before thee, the friend of thy heart!
Say, oh! was it meet that no requiem read o'er him!
No mother to weep, and no friend to deplore him,
And thou, little guardian, alone stretched before him,
Unhonour'd, the pilgrim from life should depart."

The more we know of this wonderful species, the greater reason shall we find to admire that beneficent Being, who gave the dog to man as his companion and friend, and the greater indignation shall we feel against the worse than brutal human beings, who, abusing the devotion of this most affectionate and docile creature, give to their half human attendants no return of kindness; but treat them with cruelty, and recompense their good offices with blows.

TWELFTH WEEK—SATURDAY.

I. GEOLOGY.—ITS PHENOMENA CONSISTENT WITH THE MOSAIC ACCOUNT OF THE CREATION.

The existence of mountains, which, in the volume on Spring, will be shown to be a most beneficent arrangement, modern geology has proved to be owing to a general disruption of the original crust of the earth. On its first formation, the surface of our globe must have been a plain, or, at least, very nearly approaching to it. The rocks and minerals of which it is now composed, are, on good grounds, believed to have been originally in a liquid state; and, whether fire or water were the agents employed, or if, what is more probable, *both* of them were employed either separately or together, the strata of the earth must, by the law of gravitation, have been formed horizontally, and the surface must then have been level. This introduces us to a most curious and interesting subject; and I intend to devote a few

papers to a rapid view of the discoveries of the geologist; but before entering on this alluring field, it seems proper to advert to the attack which has been made by infidel writers on the Mosaic account of the creation; that this matter being put on its proper footing, we may be enabled to proceed with safety and freedom.

These writers allege, that there are incontrovertible proofs of the existence of the world before the era assigned to the Mosaic creation; and that all geological appearances concur in bearing evidence, that many existences, both organized and unorganized, instead of being created in six days, have been successively produced and remodelled in the course of many hundreds, perhaps thousands of ages.

Now, granting all this to be distinctly established,—for I do not think it necessary to dispute the general view thus stated, much less am I inclined to call in question the facts by which it is supported,—there are two ways by which these appearances have been attempted to be reconciled to the Mosaic account. The first, and ordinary way is, by supposing that the six days, mentioned by Moses as the period in which Creative power was exerted, may be interpreted to mean so many ages of indefinite extent: And in support of this opinion there are not wanting plausible arguments. The word *day* is assuredly often taken in Scripture to signify an age or an era; thus, we read of "an acceptable day," and "a day of vengeance," and, still more distinctly, of "the latter day," "the day of judgment," and "the day of salvation," all which expressions are evidently meant to indicate, not a natural day of twenty-four hours, but a peculiar period in the actings of God's providence. Again, it has been argued, that the various works assigned to each day, when taken for an era, correspond, with wonderful exactness, to the geological indications; the chaos, when all the elements were in a mixed and turbid state; the separation of the principle of light; the subsidence of the waters, and the appearance of dry

ground; the creation of the vegetable kingdom; then of the inhabitants of the sea; then of the inhabitants of the land; and last of all of man, seem to follow in the precise order of succession which the various periods marked by the labours of the geologist appear very clearly to sanction. All this might appear to be satisfactory, were it not that the sacred writer seems anxiously to preclude the possibility of such an explanation, by ending the account of each day's operations in these words, "And the evening and the morning were the first—(the second, the third, &c.)—day," a mode of expression which seems very emphatically to confine the duration of the work, in each instance to a natural day, or a revolution of the earth on its axis, although this, doubtless, may then have been much more tardy than it is at present.

This method of getting quit of the difficulty, seeming, therefore, to be untenable, we are bound to receive the Mosaic account of the creation in the natural and unstrained sense of the words, as an inspired, and therefore true representation of the succession of visible appearances on each of the six days of this first week of time, as connected with the system in which man was brought into existence; but the inquiry is still open,—whether or not the materials, of which our present world is composed, might have been made use of by the Eternal Creator, at a period, or during a succession of periods, previous to that of the creation recorded by Moses.

In looking at the account contained in the first chapter of Genesis, with this inquiry in our minds, what do we see? First of all we have an affirmation, in general terms, that God is the Creator of all things: for, I think it will readily be conceded, that nothing more than this is meant by the expression, "In the beginning God created the heavens and the earth." Then follows a declaration, that immediately before the commencement of the Mosaic creation, the materials of which the new world was to be composed were already in ex-

istence, but in a chaotic state, "The earth was without form and void, and darkness was upon the face of the deep; and the Spirit of God moved upon the face of the waters." Nothing is said of the preceding state of this chaos; because the business of the sacred historian lay entirely with the world as it now exists; but, undoubtedly, there is here no assertion which precludes the previous use of the materials, on which the Almighty was now beginning to operate; on the contrary, the very existence of these materials, if it does not imply, at least renders plausible, the supposition, that they may at some still earlier period have been employed in some other manifestation of the Divine perfections.

Now, if we are permitted to take this view, all the objections of the geologist, arising from the appearances which indicate the existence of organized and living beings long before the era of man, vanish at once. Should it be found, that for many thousands, or even millions of years, the matter of the earth was in existence before the creation of the human race, and that it had been made use of by Him whose being is from eternity, as the habitation of other modes of vegetable and animal life, in many successive epochs, and with a constant progression toward higher powers and more perfect forms, such facts, so far from invalidating the Mosaic account, seem perfectly consistent with the analogy of revealed religion, which is itself progressive, and the belief of them is even favoured by the manner in which the account of what must then be considered as the *latest* creation, is introduced.

This is the view, then, which I am disposed to take, though I am quite aware that some highly ingenious attempts have been made to reconcile all geological appearances, to the opinion, that the materials of the world did not exist previous to the Mosaic account,—the soundness of which I am not interested to dispute. In any case, the evidence of Scripture, which rests on separate grounds, and is unimpeachable, must be received as

paramount. Let every human system, however plausible, perish, which contradicts the word of eternal truth. *Magna est veritas et prævalebit.**

* Since writing the above and the succeeding articles on Geology, and while this work was going through the press, Dr Buckland published his highly interesting and valuable Bridgewater Treatise on this important subject. The additional information which I have derived from perusing it, and which my limited plan suffers me to notice, as it cannot now be readily embodied in the text, will be added in foot notes. It is a great satisfaction to me to observe that this intelligent author has adopted the same view with myself as to the mode of reconciling the Mosaic account with the discoveries of Geology,—a view which he states himself to have long entertained, and to have previously given to the world in his Inaugural Lecture, in 1820. He also quotes some other authors as agreeing with him in this method of reconciliation, such as Dr Chalmers, Bishop Gleig, a writer in the Christian Observer, &c. My own opinion, which was formed independently of these writers, I can now advance with greater confidence Dr Buckland enters into some details of the six days creation, supported by critical notices on the Hebrew text, by the Regius Professor of Hebrew in Oxford (Pusey), which are very satisfactory. It is shown that the Hebrew, word *(bara)*, which we translate "created," does not necessarily signify formed *out of nothing*, though it is a stronger word than *asah*, made; and it is also stated, that when in the fourth commandment it is declared, that "in six days the Lord made heaven and earth, the sea, and all that in them is;" the word employed is nót *bara*, but *asah*, from which it is inferred that it expresses nothing more than "a new arrangement of materials which existed before."

THIRTEENTH WEEK—SUNDAY.

THE DELUGE A DIVINE JUDGMENT.

THE account which the Bible gives us of the history of the antediluvian world, and of the causes which led to that awful interference of the great Creator, which brought it to a sudden and violent end, may be stated in few words. After man had proved himself unworthy of the world of happiness in which he was placed, it pleased the Eternal to continue his existence, under a new condition, both of his own mental and physical powers, and of the constitution of external nature. What that condition was, we have already partly seen. It was a state of things, in which sin, misery, and death, were to prevail, as a preparation for another and more glorious form of existence, to be obtained, by believers, through the mediation of a Redeemer; and it was also part of this new condition, that men should still be so far morally free, as to have it in their power to reject the offered salvation, and remain under the dominion of the prince of darkness. Thus mankind came to be divided into two great parties, as seen by the Omniscient eye,—those who, accepting of the promised Saviour, were maturing for the mansions of heaven; and those who, preferring the things of time to the hopes of eternity, were doomed to everlasting destruction. The external condition of men was, in the antediluvian world, early marked with a broad line of distinction, corresponding, in some degree, with their future destiny. There were two distinct races of the human family,—the one descended from the first murderer, acute, ingenious, and worldly, gave themselves entirely to the cultivation of those pursuits and pleasures, which begin and end on this side the grave; the other, taking their origin from a more high-minded

parent, and, like him, full of views and expectations, which looked beyond the present earthly scene, were animated by that Hope, of which it has been beautifully said, that she "lights her torch at Nature's funeral pile;" and made it the noblest aim of their lives, to walk worthy of their immortal destiny, and to prepare for the exalted employments and enlarged happiness of celestial natures.

In the slight glimpse afforded us of these two races, we find a striking example of a peculiarity in the human character, which our Saviour has noticed, and which has characterized man in every age,—that the children of this world are wiser in their generation than the children of light. Among the descendants of Cain, who are designated by Moses as the "children of men," we see much worldly wisdom. We find their peculiar character indicated in these short incidental notices,—they built cities; they possessed flocks and herds; they invented musical instruments; they dug into the bowels of the earth, and became artificers in brass and iron;—in short, they founded the arts of civilized life, and made large advances in its comforts and luxuries. Among the pious race of Seth, who were distinguished from the irreligious family by the honourable title of "Sons of God," we hear little of worldly accomplishments, though they doubtless studied the works of creation, that in them they might discern and adore the Creator's perfections, and were not neglectful of whatever might contribute to the comfort of social and domestic life, or enlarge the understanding, or improve the heart; but, what is of much greater importance, and indicates a far nobler character, we are told of Enoch, who walked with God, and was not, for God took him, and of Noah, who was just and perfect in his generations.

But the contagion of iniquity is fearful. In all ages, it finds a predisposition toward it in the heart of every man, and probably its influence was greatly aggravated in the primeval epoch, by a life extending to many cen-

turies, and by the peculiar vigour of the bodily powers. Whatever force there may be in this latter observation, it is certain, that as soon as the pious race, merging their horror of irreligion in their admiration of human talent, began to cultivate a familiar intercourse with the infidel race, their characters from that instant began to decline; and, frequent intermarriages having taken place among them which hastened the disease, corruption became universal and inveterate, and the earth was filled with violence. At length the measure of their iniquity became full. The world, as it then was, had fulfilled its purpose, and the family of Adam had proved themselves incapable, under the circumstances in which they were then placed, of honourably fulfilling the relations of life, or of preparing for the enjoyments of a better world. A new constitution of things was to succeed, in which human life was to be curtailed, the world was to be rendered less exuberant in its vegetable productions, some of the largest animals, probably, were to be exterminated, and other corresponding changes were to be made in further development of the Divine decrees. A new step, in short, was to be taken toward the accomplishment of the primeval promise, that "the seed of the woman should bruise the head of the serpent."

The antediluvian world was therefore to be destroyed, and means having been taken for the preservation of all living species intended to people the new earth, from man to the minutest insect, "the fountains of the great deep were broken up, and the windows of heaven were opened,"—by some amazing convulsion, in which the agency of natural causes was probably employed, an irresistible and overwhelming flood poured over the face of the whole earth, and, amidst the jarring of commingled elements, the work of destruction was accomplished. This awful event is thus graphically described by Mr Sharon Turner, in the concluding sentence of his able work on the History of the Creation, &c.—"We can but faintly conceive the appalling scene. Mankind were

surprised, in the midst of their usual festivities and employments, by the sudden alarm of portentous danger, rapidly rushing on them from the blackening and howling sky. The sun was seen no more,—midnight darkness usurped the day,—lightnings dreadfully illuminated,—thunder rolled with unceasing fury,—all that was natural ceased; and, in its stead, whirlwind and desolation,—earth rending,—cities falling,—the roar of tumultuous waters,—shrieks and groans of human despair,—overwhelming ruin,—universal silence,—and the awful quiet of executed and subsiding retribution."

In the history of these first ages, a most instructive lesson is taught us with regard to the nature and consequences of mere human talent, destitute of divine illumination. Wedded to earth, the infidel branch of the human family sought an earthly reward, and obtained it. They "found out many inventions;" they increased in wealth, and surrounded themselves with conveniences and luxuries. In the eager course of selfishness, the boundaries of knowledge were extended,—desire was enlarged, the faculties sharpened, and the taste refined. But in this worldly progress what became of morality, and where was the place of religion? Alas! they had fled. The pursuits of the world are essentially grovelling;—they debase, harden, and contract the heart. Sensuality brutifies it; passion inflames it; evil communications corrupt it. Avarice is grasping, pride is arrogant,—ambition bloody. Even science itself, when pursued in a worldly spirit, is full of snares; in its self-sufficiency it usurps the sceptre of heaven, and banishes God from the throne of the universe.

The awful catastrophe of the Deluge presents the Almighty before our minds in the tremendous light of an avenging and unrelenting judge; and, in contemplating it, we seem to lose sight of the lovely attributes by which the Universal Parent is endeared to the hearts of His children. But, when we divest the event of those adventitious qualities which the excited imagination

throws around it, and view it in the pure light of truth, we perceive that, after all, except as regards time and manner, there was nothing more dreadful than what happens in the ordinary course of Providence. Every thing that lives is destined by the condition of its nature to die,—some in infancy,—some in the opening blossom of youth,—some in the full vigour of matured faculties,—and some in hoary age. And what greater calamity than this invaded the animal creation when the flood swept them away? They died, indeed, *together*, and the mode of their dissolution was violent and unusual. But was there not, even in these very circumstances, much to alleviate the calamity? What varieties of protracted suffering were avoided! How many pangs of heart-rending sympathy were spared! There were no torturing diseases,—no restless nights,—no tedious watchings,—no orphan children,—no sorrowing parents,—no widowed wives,—no bereaved husbands. To perish by flood! It is one of the easiest of deaths. To die together! It is a consummation which affection desires.

But beyond death! This is the awful thought.—Mysterious and appalling dispensation! Scene of horror and despair! Yet, in this respect, the Deluge was not different in its consequences from a common deathbed. The crisis was sudden, indeed, but if the world was taken by surprise, it was not for want of ample warning. During the eventful period in which the ark was building,—a period of a hundred and twenty years,—Noah was "a preacher of righteousness," and "the long suffering of God waited."* This intimates to us the opportunity which even to the very last was afforded for penitence, and shows to what extent the conscience was seared, and how irretrievable was the moral and religious character of the world. And what a warning does it afford to us! The world will never indeed be again overwhelmed by a flood;—but every individual of the human family, generation after generation, will go down to the dust from

* 1 Peter, iii. 20, and 2 Peter, ii. 5.

which he was taken, and his soul will be required of him for final judgment. We know not when this event will occur to any individual; but we are daily warned that the time is at hand; and ought we not to have "our loins girded about and our lamps burning?"

Nor must it be forgotten that the period is approaching when the world shall be destroyed, not indeed by water, but by fire; and that the latter catastrophe will come as suddenly and as little expected as the former. "As it was in the days of Noe, so shall it also be in the days of the Son of Man. They did eat, they drank, they married wives, they were given in marriage, until the day that Noe entered into the ark, and the flood came and destroyed them all."* How happy will those be who shall have taken shelter from such calamities under the everlasting wings, and to whom, in whatever form the King of terrors advances, he shall prove a messenger of immortal glory.

THIRTEENTH WEEK—MONDAY.

II. GEOLOGY.—SUCCESSIVE PERIODS OF DEPOSIT.

Assuming the existence of matter for an indefinite period before the commencement of the Mosaic creation, let us attend to the opinions which have been adopted by modern geologists, from views founded on the knowledge they have acquired of the crust of the earth.

It should seem, according to these inquiries, that there are three well marked periods in the primitive history of our globe, during which the most extensive changes have taken place on its surface, and fresh deposits have been made. The order of time in which these changes have been effected, can be fixed, as is supposed, with

* Luke xvii. 26, 27.

considerable precision. We are first informed, that there was what may be called the primitive era, or period of granite, when this species of rock, with other stony substances, and the wide-spread ocean from which, in the process of ages, extensive deposits of sand were made, seem to have covered the whole face of the earth, forming a cheerless and gloomy waste, destitute of organized existences, and void of life. This epoch is said to have been followed by another period of long duration, in which some violent convulsions have taken place, and active powers have been at work, effecting extensive changes, without appearing, during its continuance, to have settled down into a permanent state; hence called the transition period. It is during this period, that the first rudiments of vegetable and animal existences seem to have taken their origin, as the lowest kind of organized beings are found embedded in its deposits.* Resting on these, and therefore believed immediately to succeed them in the era of their deposition, come the rocks of what has been called the secondary epoch, during which, along with a distinct and peculiar

* "Beginning with the animal kingdom," says Dr Buckland, "we find the four great existing divisions of *Vertebrata*, *Mollusca*, *Articulata*, and *Radiata*, to have been coeval with the commencement of organic life upon our globe. No higher condition of Vertebrata has yet been discovered in the transition formation than that of fishes." "The Mollusca, in the transition series, afford examples of several families, and many genera, which seem at that time to have been universally diffused over all parts of the world." "The earliest examples of Articulated animals, are those afforded by the extinct family of Trilobites." These seem to have perished at the end of this series. "The Radiated animals are among the most frequent organic remains in the transition strata. They present numerous forms of great beauty." Of the vegetable kingdom in this earliest period of organized existences, Dr Buckland says, "In the inferior regions of this series, plants are few in number, and principally marine; but in its superior regions, the remains of land plants are accumulated in prodigious quantities." They form, in their destruction, a great part of our present coal fields, and many strata of the carboniferous order contain subordinate beds of a rich argillaceous iron ore. "A formation," adds our author, "that is at once the vehicle of two such valuable mineral productions as coal and iron, assumes a place of the first importance among the sources of benefit to mankind; and this benefit is the direct result of physical changes which affected the earth at those remote periods of time, when the first forms of vegetable life appeared upon its surface."

vegetation, animals have existed, chiefly the inhabitants of the waters, or saurian reptiles, of gigantic forms, partly marine, partly amphibious, and partly terrestrial; and, at the same period also, have lived mammalia of the marsupial order, and some testudinata and feathered tribes; as, not only their petrified remains, but, what is still more remarkable, the marks of their footsteps on sandstone have recently been found to testify.* To this, again, is believed to have succeeded another epoch, during which rocks, of what is called the tertiary formation, have been deposited, and animals, as well as plants,

* Dr Buckland, in speaking of fossil Testudinata, says, "The remains of land tortoises have been more rarely observed in a fossil state. Cuvier mentions but two examples, and these in very recent formations, at Aix, and in the Isle of France. Scotland has recently afforded evidence of the existence of more than one species of these terrestrial reptiles, during the period of the new red or variegated sandstone formation. The nature of this evidence is almost unique in the history of organic remains." In a foot note he states that a discovery of fossil footmarks, similar to that made at Corncocklemuir, and communicated by the present writer to the Edinburgh Royal Society, in 1828, has recently been made in Saxony, at the village of Hessberg, near Hildburghausen, in several quarries of grey quartzose sandstone, alternating with beds of red sandstone, nearly of the same age with that of Dumfries, of which notices have been given by Dr Hohnbaum, Professor Kaup, and Dr Sickler. In another place he also mentions foot-marks of several extinct species of birds, having very lately been found by Professor Hitchcock, in the new red sandstone of the Valley of Connecticut, one of them of a species of enormous dimensions, which took a stride of six feet. On the subject of these discoveries, with particular allusion to that in Corncocklemuir, Dr Buckland has the following elegant observations:—"The historian or the antiquary may have traversed the fields of ancient or of modern battles, and may have pursued the line of march of triumphant conquerors, whose armies trampled down the most mighty kingdoms of the world. The winds and storms have utterly obliterated the ephemeral impressions of their course. Not a track remains of a single foot or a single hoof, of all the countless millions of men and beasts, whose progress spread desolation over the earth. But the reptiles that crawled upon the half-finished surface of our infant planet, have left memorials of their passage enduring and indelible. No history has recorded their creation or destruction; their very bones are found no more among the fossil relics of a former world. Centuries and thousands of years may have rolled away, between the time in which these footsteps were impressed by tortoises upon the sands of their native Scotland, and the hour when they are again laid bare, and exposed to our curious and admiring eyes. Yet we behold them stamped upon the rock, distinct as the track of the passing animal upon the recent snow; as if to show that thousands of years are but as nothing amidst eternity;—and, as it were, in mockery of the fleeting perishable course of the mightiest potentates among mankind.

of a larger and more perfect kind, and approaching nearer to those of our own era, have existed.*

This latter period is believed to have immediately preceded the Mosaic creation, and to have ended in some universal catastrophe, which entirely broke up and deranged the whole face of the earth, destroying all vegetable and animal life, and reducing the whole materials of the globe to that state of chaos which the sacred historian so laconically, but emphatically describes, when he says, that "the earth was without form and void, and darkness was on the face of the deep."

It would be inconsistent with my plan to enter, with any minuteness, into a detail of the arguments by which geologists maintain the truth of these views; but I may mention, in a single sentence, that the rocks called primary, obtain this name, because, though they frequently are found to have burst through all the other strata of which the crust of the earth is composed, and even to

* The Tertiary epoch has recently been divided into four periods, founded on the proportions which their fossil shells bear to marine shells of existing species. During the first period, these productions bear but a small resemblance to our present orders, but this resemblance increases through each successive period, till the greater proportion of the fossil species come to bear a distinctly marked affinity to present existences. A similar remark may be made with regard to the inhabitants of the land. By far the greater proportion of the genera which existed during the earliest period of this epoch, are now extinct, while the terrestrial animals of the latest period have very generally antitypes in the living species of our own era. "It appears," says Dr Buckland, "that at this epoch the whole surface of Europe was densely peopled by various orders of Mammalia, that the numbers of the *herbivora* were maintained in due proportion by the controlling influence of *carnivora;* and that the individuals of every species were constructed in a manner fitting each to its own enjoyment of the pleasures of existence, and placing it in due and useful relations to the animal and vegetable kingdoms by which it was surrounded." He then concludes his observations on the Tertiary series with the following just and striking remarks:—"Every comparative anatomist is familiar with the beautiful examples of mechanical contrivance and compensations which adapt each existing species of *herbivora* and *carnivora*, to its own peculiar place and state of life. Such contrivances began not with living species. The geologist demonstrates their prior existence in the extinct forms of the same genera, which he discovers beneath the surface of the earth; and he claims for the Author of these fossil forms, under which the first types of such mechanisms were embodied, the same high attributes of wisdom and goodness, the demonstration of which exalts and sanctifies the labours of science, in her investigations of the organizations of the living world."

overtop them all, forming our most elevated mountain ranges, yet they uniformly dip deeper down below the earth's surface than all the rest, and form the substratum on which the others recline. Immediately above these, lies the transition deposit, then the secondary, and then the tertiary formations. The obvious conclusion is, that, if we may at all suppose successive periods of deposit, these periods must have occurred in the order we have described; and the existence of peculiar forms of organized beings, connected respectively with these periods, while it strangely excites curiosity, and gives a very deep and mysterious interest to the subject, by opening up, as it were, a glimpse into former worlds, cannot readily be accounted for in any other way than by the hypothesis of successive epochs and successive creations. If, indeed, the plants and animals of one formation were found intermingled with those of another, there might be some ground for hesitation. But this is not the case; and, what is particularly worthy of remark, it appears that the whole individuals of the organized beings, which existed during those primeval periods, had been destroyed before the era of the Mosaic creation, none of such species being in existence at the present day.

What a surprising, and at the same time consistent, view does this open up, of the operations of the Eternal Mind. We have been accustomed to think of the Self-existent Being as only beginning to exert his creative energies, within the last six thousand years, when our globe was brought out of a state of chaos, and the human race was formed. But it is natural for the inquiring mind to ask, if it be indeed true that an eternity had past before the Almighty displayed his perfections, by calling worlds into existence, and exercising over them that paternal care which is so conspicuous and so endearing in the present state of things. This inquiry we may not be able satisfactorily to answer; but it is undoubtedly a step toward the solution of the question, to discover, that the materials of which the present earth is composed, have

been employed by the Creator, in previous periods of unknown but vast duration, in the formation of other worlds, of which other beings, strangers to the existing earth, were denizens; and we seem to acquire a more sublime idea of the Divine perfections, when we think of those primeval times, "in which plants and flowers, now totally unknown, adorned the face of nature, and rose to luxuriance under warmer suns; in which animals of different forms and species, roamed the woods and forests; and in which the ocean rolled its billows, and the finny tribes found food and enjoyment, where now fertile fields wave with grain, and the lofty trees of the forest throw their boughs toward heaven, and man and beast tread the solid ground."*

THIRTEENTH WEEK—TUESDAY.

III. GEOLOGY.—SUCCESSIVE PERIODS OF ORGANIZED EXISTENCES.

If the view of our modern geologists, which I have adopted, be correct, there is something exceedingly interesting, and certainly, as I have already observed, not inconsistent with the character of the Creator, as we read it inscribed on His works, in the gradual development of the powers of nature, and in the adaptation of living beings to the progress of that development. "In the beginning," the earth was, according to this hypothesis, created a mass of inert matter, perhaps in a liquid state from excessive heat, but crystallizing as it cooled, till the whole crust of the globe was comprised in the two great divisions of sea and crystallized rocks, surrounded with an atmosphere. This was its primitive state; and, under these circumstances, neither vegetables nor animals could

* Study of Nature, p. 202.

exist; but, being intended for the habitation of living beings, the powers inherent in matter were employed in breaking down, abrading, and disuniting the harder substances, so as to form soil fit for the maintenance of vegetable produce; and thus, in process of time, it passed into the transition state. No sooner was the globe, to this extent, prepared, than vegetables were created by the Almighty hand; and food being thus produced for living creatures, these also were called into being, with faculties and endowments admirably fitted for the earth, as it then was. Still the process of decomposition and crumbling down went on, till the world became fitted for a new change. A catastrophe, therefore, took place, by which all organized existences were destroyed and submerged; and, by a most wonderful provision, these were laid up in storehouses, as it were, below the surface, for the future use of the rational creatures which were, in the succession of ages, to be created, being meanwhile, by pressure and disintegration converted, the marine productions into lime, and the produce of the land into coal. And now a new operation of creative wisdom takes place. More nourishing qualities have been infused into the waters of the sea, and the surface of the earth has acquired more fertile powers, by which the whole globe is fitted for the maintenance of higher species of plants and animals. They are accordingly produced. A more noble and luxuriant vegetation clothes the face of the earth. Living creatures of gigantic proportions swim in the ocean, or frequent the vast swamps and marshes which compose its shores, or browse among the mighty palms and ferns which spring up on the elevated grounds. But the wonderful plan formed in the Eternal Mind is not yet completed. Another period elapses, in which further changes have been going on, and continued preparations have been making. At length new epochs arrive, and new catastrophes take place. Again and again the surface of the globe is broken up; its vegetable and animal productions are again and again

entombed, to add to the stores of the higher race destined to appear in a new era and a renovated world.

Last of all, the time arrives, when the globe is fitted for a race of rational creatures. "The earth is without form and void." The elements are commixed; and thickest darkness broods over the profound abyss. God speaks; it is light, and the clouds ascend. He speaks again; the solid foundations of the world are disturbed; an irresistible force heaves the ancient granite from its bed, causing it to shake off the superincumbent strata which ages had formed, and to throw aloft its rugged peaks, till they threaten to penetrate the sky. The waters subside, and are gathered together. An effectual separation is thus made between the seas and the dry land, and a new character is given to the earth's surface, which fits it for its coming destiny.* Once more the Creator utters his voice. "The earth brings forth grass, the herb yielding seed, and the fruit-tree yielding fruit." Yet again the command is issued, and the clearing atmosphere gives free admittance to the direct rays of the sun, moon, and stars.† Thus is the world once more prepared as the

* "It is marvellous that mankind should have gone on for so many centuries in ignorance of the fact, which is now so fully demonstrated, that no small part of the present surface of the earth is derived from the remains of animals, that constituted the population of ancient seas. Many extensive plains and massive mountains form, as it were, the great charnel-houses of preceding generations, in which the petrified exuviæ of extinct races of animals and vegetables are piled into stupendous monuments of the operations of life and death, during almost immeasurable periods of past time." "'At the sight of a spectacle,' says Cuvier, 'so imposing, so terrible as that of the wreck of animal life forming almost the entire soil on which we tread, it is difficult to restrain the imagination from hazarding some conjectures as to the causes by which such great effects have been produced.'"—*Buckland's Bridgewater Treatise*, p. 112.

† Speaking of the 14th, and four succeeding verses of the first chapter of Genesis, Dr Buckland, in precise agreement with what is stated in the text, thus argues:—"What is herein stated of the celestial luminaries, seems to be spoken solely with reference to our planet, and more especially to the human race, then about to be placed upon it. We are not told that the *substance* of the sun and moon were first called into existence upon the fourth day. The text may equally imply that these bodies were then prepared, and appointed to certain offices of high importance to mankind: 'to give light upon the earth, and to rule over the day, and over the night;' 'to be for signs, and for seasons, and for days, and for years.' The fact of

residence of living beings; and *they* are created. The broad spread sea and swelling earth teem with animation; and, last of all, Man is formed in the image of God. His Creator "breathes into his nostrils the breath of life, and he becomes a living soul:"—the lord of this nether sphere stands confessed.

Such is the progress which, according to modern geology, corrected by the lights of Scripture, has formed the earliest history of creation. The system, perhaps, deserves no higher name than that of a theory; but it is a beautiful and consistent theory, which accounts for many facts, and is contradicted, so far as I know, by none. It is exceedingly gratifying to human genius to have thus found the means of penetrating beyond the darkness of ancient chaos, and the confusion of mingled elements; and it is not less instructive than gratifying, to be able to trace, even in these mysterious primeval times, the designing hand of Infinite Wisdom and Goodness; to see the very same character impressed on the works of the Creator, in such incalculably remote periods, which we mark with so much delight in the history of the world, since that latest epoch, in which the human race was formed, the chief of His terrestrial works; and in which subordinate organized beings, in a scale descending by almost imperceptible links, till they

the creation had been stated before in the first verse. The stars also are mentioned (Gen. i. 16.), in three words only, almost parenthetically, as if for the sole purpose of announcing that they also were made by the same Power as those luminaries which are more important to us—the sun and the moon. The interpretation here proposed seems, moreover, to solve the difficulty which would otherwise attend the statement of the appearance of light on the first day, while the sun and moon and stars were not made to appear until the fourth. If we suppose all the heavenly bodies and the earth to have been created at the indefinitely distant time designated by the word 'beginning,' and that the darkness described on the evening of the first day, was a temporary darkness, produced by an accumulation of dense vapours 'upon the face of the deep,' an incipient dispersion of these vapours may have readmitted light to the earth, upon the first day, while the exciting cause of light was still obscured; and the further purification of the atmosphere, upon the fourth day, may have caused the sun and moon and stars to reappear in the firmament of heaven, to assume their new relations to the newly modified earth, and to the human race."

become confounded with inanimate matter, were associated with them.

One objection I anticipate. Why, it may naturally be asked, this progression and long delay? Why was that Infinite Power not put forth at once, which was to form the world in its highest state of perfection? Could not the same Almighty hand, which, according to this theory, formed the earth an inert mass, and left the development of its productive qualities to a succession of ages, have called it into being, in all its glory, by a single word? Undoubtedly it could; and the reason of a different mode of operation may be inscrutable by the human mind. But who does not see that such progression is in accordance with the usual analogy of the Divine operations; and that the very same objection might be urged against the progress of society in the arts and in civilization; against the gradual unfolding of the eternal decrees in the history of revealed religion; against the slow growth of an oak; or against the tardy expansion of the human powers through the various stages of infancy, youth, and manhood. Time is, even with man, but a relative term. In the counsels of Him, with whom "a thousand years are but as one day," it dwindles to a point

THIRTEENTH WEEK—WEDNESDAY.

IV. GEOLOGY.—STATE OF THE ANTEDILUVIAN WORLD.

The arrangements on the surface of the earth, at the Mosaic Creation, were, doubtless, in many respects, different from what they are at present. I do not allude to its state as it came first from the hands of its Creator, when all things bore the recent impress of a Divine hand, when Paradise bloomed, and the gentle air breathed balm, and, on the young vegetable and animal world,

the blessing of a benignant Heaven shed peace, grandeur, and loveliness; but I speak of it after the blight of an alienated Deity had fitted it for the habitation of a fallen and guilty race, who were to earn their subsistence amidst toil and care, strangers and pilgrims on their native earth, and under training, by a course of discipline, for new states of existence in another sphere.

Of the actual condition of the antediluvian world, we have scarcely any recorded materials from which we can draw correct geological conclusions. We are informed, however, that the life of man extended to a period of tenfold greater duration than it does at present, which indicates a much greater salubrity of the atmosphere; and it is remarkable, that the organic remains of that first period of the human history, correspond with this indication. The state of the air and of the seasons, which was so healthful for man, may readily be supposed to have been equally favourable to the nourishment of other organized existences; and if we are to look for proofs from geology to confirm the assertion of the sacred volume on this point, we must seek for it in a greater luxuriance in the growth of plants and animals. Man himself, who seems not to have arrived at the period of puberty before sixty or seventy years of age, was probably of superior stature,—a conjecture which is confirmed by the existence of giants, as we are expressly assured, both before the flood, and for some time after it. However this may be, it is remarkable, that we have undoubted proofs, from antediluvian remains, that many of the organized existences of that period were of much greater dimensions than are now to be found, either in the vegetable or animal kingdoms. Tropical plants seem to have spread over our temperate regions in great luxuriance of vegetation, and among animals there are found, in these regions, some of immense proportions, whose species are now extinct, or, if still existing, as in the case of the tapir, are greatly diminished in size. From these facts, we have evidence that the antediluvian

climate was peculiarly genial, and therefore we need not be surprised to find that it was far more favourable to human life, than the mingled and polluted atmosphere in which we at present exist.*

In another respect, too, the aspect of the antediluvian world must have been considerably different from its present state.* Since that early period, a deluge has swept over its surface with tremendous force, levelling hills, filling up valleys, scooping out ravines, altering the bed of the ocean, and blotting out, perhaps, whole continents from the map of the world, while it raised

* In this view of the superior salubrity of the antediluvian climate, the author is directly opposed to the speculations of Bishop Sherlock, who imagines that the curse pronounced on the ground rested upon it "in all its rigour," only till the flood, up to which period it rendered the work and toil necessary to raise from the ground a sufficient support for life, a grievous and irksome burden," but that, after this catastrophe, that part of the curse which referred to the soil was removed, and the world was, in this respect, restored to its primeval beauty and fertility. This strange notion rests for its support on two texts of Scripture, the first of which is the reason given by Lamech for naming his first born son Noah, which means *comfort*, viz. "This same shall *comfort* us concerning our work and toil of our hands, because of the ground which the Lord hath cursed," (Gen. v. 29). Those who have noted the custom which prevailed from the earliest times, of recording a reason for the naming of children at or soon after their birth, will scarcely see in this passage any thing more than the delight and pious gratitude of a father, for the gift of a son who should assist him in his agricultural labours The Bible is full of similar birth-day sayings; thus Eve called her first born son Cain, which signifies *gotten*, for she said "I have gotten a man from the Lord;" and when, after the murder of Abel, she had another son, she called him Seth, which signifies *appointed*. "For God," said she, "hath *appointed* me another seed, instead of Abel, whom Cain slew." A hundred other instances might be mentioned.

The other text on which Sherlock builds his theory, can scarcely be considered of greater weight. It is the promise contained in the two last verses of the eighth chapter of Genesis. "I will not again curse the ground any more for man's sake, neither will I again smite any more every thing living as I have done. While the earth remaineth, seed-time and harvest, and cold and heat, and summer and winter, and day and night, shall not cease." The Bishop argues that these words intimate the removal of the curse, and the restoration of a greater stability of the seasons; but surely this is an unwarranted stretch of the meaning of a text which simply declares that no such calamity as the flood shall ever again visit the earth. The vigour of the human constitution in the antediluvian ages, which is distinctly asserted, is alone sufficient to overturn the Bishop's theory; and the same thing seems to follow from the fact, that the gift of animal food was not added to that of vegetables, till after the flood,—an indication of the superior fertility and abundance, in the earliest ages, of plants fit for human subsistence.

others in their place:* By the action of this great catastrophe, very large additions must have been made to the productive soil of the earth, from the effects of detrition; but even then the soil appears to have been abundant, at least in many and extensive portions of the globe; and, whatever changes have been made, of which we shall speak more particularly in another paper, the general character of the terraqueous globe, and its inhabitants, must have been, with the exceptions already hinted at, nearly the same as at present. There was not

* Dr Buckland doubts whether the evidence which certainly exists of a flood of immense force sweeping over the surface of the earth, refers to the Mosaic deluge, or to that which submerged the world immediately before the creation of man. "It has been justly argued," says he, "against the attempt to identify these two great historical and natural phenomena, that, as the rise and fall of the waters of the Mosaic deluge are described to have been gradual, and of short duration, they would have produced comparatively little change on the surface of the country they overflowed. The large preponderance of extinct species among the animals we find in caves, and in superficial deposits of diluvium, and the non-discovery of human bones along with them, afford strong reason for referring these species to a period anterior to the creation of man. This important point, however, cannot be considered as completely settled till more detailed investigation of the newest members of the Pliocene, and of the diluvial and alluvial formations shall have taken place." It is well to speak with caution when a sufficient number of facts have not been collected; but, for my own part, I see little force in the objections here stated. No deluge, which rose in a few weeks over the tops of the highest mountains, and enveloped the whole habitable globe, could possibly be tranquil. The discovery of extinct species may be accounted for by the extermination of such animals as the Creator saw would no longer be suitable to the new condition of the earth when it emerged from the waters; and the non-discovery of human bones in the places yet examined, by no means precludes the probability of finding them in the extensive regions of the East, yet unexplored, where it is universally believed the human race had their origin. Geologists jump too quickly to conclusions. How small a tract of the crust of the earth has yet been examined, and even that small tract how imperfectly!

If it should appear, however, that the organized existences of what Mr Lyell calls the Pliocene period of the tertiary formation, are sometimes, or even frequently, mingled with those which were destroyed and submerged at the Deluge, this is just what might be expected, on the supposition that the Pliocene period ended in a similar catastrophe. These existences, both animal and vegetable, would, of course, be mingled with the *diluvium* which formed the surface of the new earth, and when the fountains of the great deep were again broken up, that diluvium would be disturbed, overturned, and mixed, so as to inclose the remains of antediluvian organization in the same masses with those of the latest period of the immediately preceding formation.

only an abundant vegetation on its surface, but there were metals (brass and iron) which the labour of man could reach, and his ingenuity could convert to his use. Fire must have been employed in smelting and manufacturing these metals; and, from the slight hints which the sacred historian affords, it would appear, that the domestic arrangements of families could not have greatly differed from our own.

This may suffice as a rapid introduction to the changes which I shall next have occasion to notice—those which were occasioned by the universal deluge. Meanwhile, what a wonderful period have we been surveying!—a new world of organized beings has been created, and has perished. It came fair and perfect from the hands of its Creator. Throughout its whole bounds, there was no evil, no deformity, no death. The eye of the Almighty, as he beheld His work, "saw that it was good." It was created for the happiness of every living creature, and it completely answered the end. Every thing in the complicated machinery of Nature was, with the nicest skill, adjusted to all the rest, so that there was no jarring—no interference. All was peace, and harmony, and joy. But the adversary and destroyer came. By a mysterious providence, he was permitted to prevail. Moral evil was introduced into the rational creation, and a new order of things arose. A state of universal blessedness was converted into a state of human discipline. New adjustments became necessary, and were accomplished. The animal and vegetable world, the earth, the sea, and the air, were all accommodated to this wonderful revolution. Wintry storms desolated the land, and chafed the raging sea; earthquakes shook the solid globe; volcanoes poured forth their liquid fire; lightnings flashed, and thunder rent the sky;—decomposition, decay, and death, became the common law of organized existences;—while man, the guilty author of all this disorder, refusing to learn under the rod, waxed only more and more rebellious, till the whole world was filled

with violence, and the measure of his iniquity being full, the sentence came forth from the Creator,—"Behold! I, even I, do bring a flood of waters upon the earth, to destroy all flesh, wherein is the breath of life, from under the heavens; and every thing that is in the earth shall die." How mysterious was the forbearance which permitted the rebellion, but how just was the judgment which punished it!

THIRTEENTH WEEK—THURSDAY.

V. GEOLOGY.—INDICATIONS OF THE ACTION OF THE DELUGE AT THE PERIOD ASSIGNED TO IT IN SCRIPTURE.

I AM now to consider the geological indications of that universal deluge, by which a new epoch was formed in the history of the world, and by which, while the increasing wickedness of the human race, then existing, was visited by the Divine Governor with a signal display of His displeasure, a new order of things was prepared.

The account which the sacred historian gives of this awful event, is, that "the fountains of the great deep were broken up, and the windows of heaven were opened, and the rain was upon the earth forty days and forty nights; and the waters prevailed exceedingly upon the earth, and all the high hills which were under the whole heaven were covered; and all flesh died that moved upon the earth, both of fowl, and of cattle, and of beast, and of every creeping thing that creepeth upon the earth, and every man; and Noah only remained alive, and they that were with him in the ark. And the waters prevailed upon the earth an hundred and fifty days." It appears further from the Divine record, that, in the sixth month from the commencement of the catastrophe, the waters began to subside; and that, at the end of a year, the seas were collected, or rapidly collecting, into their present channels, and the earth had become so dry, at least in

the higher grounds, as to be again fit for the habitation of living creatures.

It has been too justly alleged, that there is a tendency to scepticism in the minds of scientific men; that, whether it be from a pride of understanding, which induces them to look down with contempt on the opinions of the vulgar, or from a consciousness of enlarged ideas, which inclines them to distrust, as contracted or superstitious, the views they have acquired in the nursery and in their elementary schools of instruction, they frequently feel a pleasure in adopting views, and maintaining principles, at variance with revealed truth. At all events, the Mosaic account of the deluge, as well as of the creation, was certainly received with incredulity by those individuals who, about the beginning of the present century, took the lead in geological investigations; and I am by no means sure, that this reproach does not still attach to many who affect the name of philosophical inquirers. Brydone, taking his argument from an Italian monk, endeavoured to throw doubt on the Scriptural account, by an allegation completely overturned, however, by subsequent discoveries, regarding the time requisite for converting lava into vegetable soil, which would have given an antiquity to the earth's present surface, far beyond the period of the flood; and Bailly used, for the same purpose, and with similar success, the false and vain-glorious chronology of the Hindoos.

Happily, however, a philosopher of a different stamp has arisen, who, by rigidly questioning Nature, without reference to any preconceived opinion, and without regard, I believe, even to the authority of Scripture, has come to the conclusion, that the appearances on the surface of the earth, indicate the origin of its present state, as having taken its date at a period corresponding, with wonderful exactness, to the Mosaic account. The words in which M. Cuvier states this satisfactory opinion, are sufficiently pointed and precise. "I conclude," he observes, "with MM. Deluc and Dolomieu, that, if there

be any fact well established in geology, it is this, that the surface of our globe has suffered a great and sudden revolution, the period of which cannot be dated further back than 5000 or 6000 years. This revolution has, on the one hand, engulphed, and caused to disappear, the countries formerly inhabited by men, and the animal species at present best known; and, on the other, has laid bare the bottom of the last ocean, thus converting its channel into the now habitable earth."*

A rapid statement of the principles on which Cuvier founds his reasoning, may suffice to show, that it does not rest on mere theoretical views, but is based on incontrovertible facts.

It is well known, that great and constant changes are going on in the surface of the earth, by the decomposing power of the atmosphere, by the effects of rain and of frost, by the decay of vegetation, by the fall of forests, by the shifting and accumulation of sand drifted with the wind, and by the continual course and occasional overflowing of rivers and mountain torrents. The effects of these agents are indeed slow, but they are constantly progressive. They prove, as I have elsewhere said, that the present condition of the world has not been eternal, because, in the revolution of countless ages, the

* That the Supreme Being, not only in the ordinary course of His providence, but even when He interferes to execute judgment, generally makes use of second causes, seems to be admitted. In the case of the deluge, He probably did not deviate beyond what is stated in the Sacred Volume, from this usual mode of operation, and human curiosity has led to the inquiry, by what natural powers the flood was effected. That there are agents in nature quite sufficient, in point of force and extent, to produce the effects described, cannot be doubted. The most obvious of these is thus stated by Dr Fitton, in his Geological Sketch of the Vicinity of Hastings. "The evidence in proof of great and frequent movements of the land itself, both by protrusion and subsidence, and of the connexion of these movements with the operations of volcanoes, is so various and so strong, derived from so many quarters on the surface of the globe, and every day so much extended by recent inquiry, as almost to demonstrate that these have been the causes by which those great revolutions were effected; and, although the action of the inward forces which protrude the land, has varied greatly in different countries, and at different periods, they are now, and ever have been, incessantly at work in operating present change, and preparing the way for future alteration in the exterior of the globe."—Pp, 85, 86.

earth would, by such means, be necessarily reduced to a level; or rather the whole land, being carried into the sea, would be submerged and overflowed by the water. Now, the rate at which these changes proceed, may be subjected to calculation; and this is what Cuvier has actually effected. He examined the progress of accumulations at the mouth of rivers, at the bottom of lakes, and in valleys; he formed an estimate of the rate at which rocks and mountains crumble, and sand, drifted from the sea, where it is formed, spreads into downs, and encroaches on the vegetable soil; and he considered the amount of detrition which takes place in ravines, and in the bottom and banks of rivers. All these causes of change he investigated with his own characteristic acuteness; and he and his associates, in carrying back their calculations, found that they all united in pointing to a period when they commenced their united operations, which, as he states, "cannot be dated further back than 5000 or 6000 years." In other words, it appears as the result of these investigations, that the present surface of the earth cannot have been more than that number of years in existence. It would seem, from what this philosopher states, when he gives a more specific account of his investigations, that, in naming these round numbers, he carries his concessions to the most extreme verge of possibility; and that his own settled opinion is, that the Mosaic account, which fixes the era of the flood at the distance of little more than 4000 years from the present time, is borne out with remarkable accuracy. In another part, afterward quoted, he expressly says,—"Geology apprises us, that, of the various revolutions which have agitated our globe, the last evidently corresponds to the period which is assigned to the deluge;" and he distinctly states 4000 years as the period indicated by the alluvial deposits.

We shall, to-morrow, give an example or two of the manner in which Cuvier conducted his inquiries on this important and most interesting subject.

THIRTEENTH WEEK—FRIDAY.

VI. GEOLOGY.—CUVIER'S CALCULATION RESPECTING THE DELUGE.

It is so desirable to remove sceptical doubts as to the actual occurrence of the deluge, that we cannot leave the subject without stating a few further geological facts, which show the coincidence of actual observation with the declarations of Scripture. As an example of the manner in which the inquiries respecting the date at which the present surface of the earth was formed, have been conducted by Cuvier, and other geologists who adopt his views, it may be interesting to quote the following passage from that distinguished philosopher's "Theory of the Earth:"—"M. de Raney, a learned member of the Institute, inspector-general of bridges and roads, has communicated to me some observations, which are of the greatest importance, as explaining those changes that have taken place along the shores of the Adriatic. Having been directed by government to investigate the remedies that might be applied to the devastations occasioned by the floods of the Po, he ascertained that this river, since the period that it was shut up by dykes, has so greatly raised the level of its bottom, that the surface of its waters is now higher than the roofs of the houses in Ferrara. At the same time, its alluvial depositions have advanced so rapidly into the sea, that, by comparing old charts with the present state, the shore is found to have gained more than six thousand fathoms since 1604, giving an average of a hundred and sixty or a hundred and eighty, and, in some places, two hundred feet, yearly. The Adige and the Po are, at the present day, higher than the whole tract of land that lies between them; and it is only by opening new channels for them

in the low grounds which they have formerly deposited, that the disasters which they now threaten may be averted.

"The same causes have produced the same effects along the branches of the Rhine and the Meuse; and thus the richest districts of Holland have continually the frightful view of their rivers held up by embankments, at a height of from twenty to thirty feet above the level of the land."

We have here a curious example of the kind and amount of detrition by which, in the course of years, the dry land is worn down, and extends itself into the sea, and facts of a similar kind are every where familiar to the geological inquirer.

Mr Fairholme, in his "Geology of Scripture," gives a striking account of the manner in which a fresh water lake has been encroached on by the land in the course of a century, which illustrates the same kind of natural action as that above mentioned, on which Cuvier founds his calculations, although, in the instance given, that action was assisted by the interference of art. Speaking of the Kander, a mountain torrent of no great size in the Canton of Berne, he says, that in consequence of the mischief done by the overflowing of that river, to a great extent of valuable meadow land, in its course to join the Arr, ten miles below the Thoun, which was its natural course, a spirited plan was, about the beginning of last century, proposed and adopted for cutting a subterraneous passage for the river through a ridge, at a place where it approached the lake. The descent was rapid, and the torrent in a few years enlarged its course, till at length the whole superstructure gave way and fell in. The effects of this soon became apparent in the lake. An immense quantity of gravel and stones was carried in by the current, and lodged in its bed; and by this means a new formation took place at the mouth of the river, which, in 1829, being little more than a century, had "produced a secondary bed of mixed materials, of

fully three hundred acres, and at least one hundred feet in depth."*

This remarkable formation took place under peculiar circumstances; but all rivers are actively employed in effecting similar changes to an extent of which those who have not attended to the subject are little aware. Major Rennell and Major Colebrooke calculate that the waters of the Ganges contain, in the season of flood, one part in four of mud, on which Mr Lyell remarks, "We are somewhat staggered by the results to which we must arrive, if we compare the proportion of mud as given by Rennel, with his computation of the quantity of water discharged, which latter is probably very correct. If it be true that the Ganges, in the flood season, contains one part in four of mud, we shall then be obliged to suppose that there passes down every four days a quantity of mud equal in volume to the water which is discharged in the course of twenty-four hours. If the mud be assumed to be equal to one-half the specific gravity of granite (it would, however, be more), the weight of matter daily carried down in the flood season would be about equal to seventy-four times the weight of the great pyramid of Egypt. Even if it could be proved that the turbid waters of the Ganges contain one part in a *hundred* of mud, which is possible, and which is affirmed to be the case in regard to the Rhine, we should be brought to the extraordinary conclusion, that there passes down, every day, into the Bay of Bengal, a mass, more than equal in weight and bulk to the great Pyramid."

I quote these examples to show that the process by which the earth encroaches on the sea, and becomes reduced in the elevation of its surface, is in many instances astonishingly rapid; but it is not on these extreme cases that Cuvier founds his calculation, but on an average of ordinary cases. He takes his observations partly from the Deltas of the Nile and the Rhone, and partly from the depositions along the shores of the sea of Asoph, and the

* P. 124.

Black Sea; and he also considers the growth of peat mosses, the extent of mountain slips, and the progress of downs; and, by collating the results of these diversified operations, he finds them, as I have already intimated, all concurring in one conclusion, which serves by a new test to verify the Scriptural account of the era of the deluge, and its universal operation.

But it may be more satisfactory to give the words of Baron Cuvier himself:—" Thus, while the traditions of all nations have preserved the remembrance of a great catastrophe, the *deluge*, which changed the earth's surface, and destroyed nearly the whole of the human species, geology apprises us, that, of the various revolutions which have agitated our globe, the last evidently corresponds to the period which is assigned to the deluge. We say, that by means of geological considerations alone, it is possible to determine the date of this great event with some degree of precision.

" There are certain formations, which must have commenced immediately after the last catastrophe, and which, from that period, have been continued up to the present day with great regularity. Such are the deposits of detritus observed at the mouths of rivers,—the masses of rubbish which exist at the foot of mountains, and are formed of the fragments that fall from their summits and sides. These deposits receive an yearly increase, which it is possible to measure. Nothing, therefore, is more easy than to calculate the time which it has taken them to acquire their present dimensions. This calculation has been made with reference to the debris of mountains; and, in all cases, has indicated a period of about four thousand years. The same result has been obtained from the other alluvial deposits. In short, whatever has been the natural phenomenon that has been interrogated, it has always been found to give evidence in accordance with that of tradition. The traditions themselves exhibit the most astonishing conformity. The Hebrew text of Genesis places the deluge in the year

2349 before Christ. The Indians make the fourth age of the world, that in which we now live, to commence in the year 3012. The Chinese place it about the year 2384. Confucius, in fact, represents the first king Yeo, as occupied in drawing off the waters of the ocean, which had risen to the tops of the mountains, and in repairing the damage which they had occasioned."

This result, so pleasing to the religious mind, has been attempted to be evaded by some ingenious writers, who, with considerable plausibility, have supported views altogether at variance with revelation, endeavouring to account for all the changes which have taken place both in the animate and inanimate creation, by a regular and uninterrupted succession of natural causes, continued for a vast but undefined period, amounting perhaps to millions of years; but with whatever ability these views have been supported, the straining of facts to which they are obliged to resort for the purpose of supporting a very untenable theory, is too apparent not to display the weakness of their cause. It is impossible, by any ingenuity, to mystify the fact that "mountains decay with years," and that there is a general tendency in nature to reduce all things to a level; which, in a period infinitely short of eternity, would reduce the sea to a muddy puddle, and the land to a swampy and pestilential marsh.

THIRTEENTH WEEK—SATURDAY.

VII. GEOLOGY.—EFFECTS OF THE DELUGE ON THE PRESENT SURFACE OF THE EARTH.

The geological marks of a universal deluge are very clearly indicated, not merely by the facts we have been already considering, but also by appearances of a different kind. Marine shells are every where found, even on the loftiest mountains. These give evidence, either that

the ocean has shifted its bed, or that it has swept over the earth as Moses has described; or, what is perhaps most probable from other indications, that both of these causes have been combined. But there are proofs of the flood still more unequivocal. There are deposits every where, which geologists have justly considered diluvial, and which, from their position on elevated ground or gentle slopes, are easily distinguished from the accumulations of lakes and rivers. "In the whole course of my geological travels," says Dr Buckland, "from Cornwall to Caithness, from Calais to the Carpathians, in Ireland or in Italy, I have scarcely ever gone a mile, without finding a perpetual succession of deposits of gravel, sand, or loam, in situations which cannot be referred to the action of modern torrents, rivers, or lakes, or any other existing causes. And with respect to the still more striking diluvial phenomena of drifted masses of rocks, the greater part of the northern hemisphere, from Moscow to the Mississippi, is described by various geological travellers, as strewed, on its hills as well as valleys, with blocks of granite, and other rocks of enormous magnitude, which have been drifted (mostly in a direction from north to south), a distance, sometimes of many hundred miles, from their native beds, across mountains and valleys, lakes and seas, by force of water, which must have possessed a velocity to which nothing that occurs in the actual state of the globe affords the slightest parallel."

The state of the earth's surface here described, must be familiar to every one who has any taste for observation. What we call soil is nothing else than rocks rubbed down by detrition, or decomposed by the action of the atmosphere, and afterward mixed with the decayed vegetable and animal substances to which it has given nourishment; and it is striking to observe with what beneficence the action of natural causes has been made to clothe the earth with a covering so admirably adapted for the purposes of organic life. The agency of the de-

luge in the whole operation is very apparent. First has rushed over the earth a wave of amazing force, bearing along with it in its resistless current every thing which existed on the surface of the globe as it then was,—destroying, submerging, and dispersing, man and beast, with all the labours of human art; tearing up and floating away, or burying deep, tree and shrub, plant and flower; throwing wide over all climates the seeds of every vegetable production, to form the germs of a new vegetation in an altered world; moving from their primeval foundations the peaks of the ancient mountains, and hurrying them broken, scattered, and rounded into stones and boulders, to distant regions, and over a wide extent; scooping out ravines, and raising waving hills of gravel and clay in the lower grounds; and, as it swept over the level tracts, depositing part of the more heavy materials with which it was loaded. After this mighty torrent, occasioned by the sudden disruption of the solid crust of the globe, had begun to subside, the turbid waters, in their slower motion, had proceeded to deposit the lighter burden with which they were fraught. The mud of this agitated and shoreless ocean, mingled with rounded stones of various size, had been gradually precipitated, and had formed a sediment of various depth, which was to serve as the vegetable soil of the future land; and this awful agent having now fulfilled the high behest of the Almighty, had gradually retired to those regions of the surface which were nearest the centre, obeying the universal law of gravitation, by which liquids find their own level.

That the actual state of the earth's surface corresponds very remarkably with this account of the manner in which a universal flood would naturally act, every one must, on the slightest survey, be sensible. But a more minute and careful examination strikingly confirms this general view. No one can look with a judicious eye on any extensive section of the upper deposits on the earth's surface, without being sensible of this. Sir James Hall

has turned the attention of geologists to the curious fact, that on the surface of sandstone, among the soil and debris which cover this early deposit, large boulders, sometimes of the same kind of rock, and frequently also of rock of a kind altogether foreign to the locality, are very often to be found; and that, where this is the case, the upper stratum of the rock is marked with grooves or scratches, generally lying in a southwest direction, and evidently attributable to the impression of these boulders, hurried along by the currents during the action of the flood. The Craigleith Quarry, in the neighbourhood of Edinburgh, which is remarkable as containing a very fine example of a fossil tree in the very heart of the secondary deposit, is a well known example of this. The intelligent manager of this extensive work, has traced these grooves over the whole surface of the quarry, whenever the diluvial soil has been removed,* and the same phenomenon is familiar to every person who is conversant with similar excavations. In the quarry of Corncocklemuir, for instance, where the footsteps of primeval animals have been discovered, it is evident that the whole upper surface of the strata has been forcibly torn off before the diluvial soil was deposited, and among that soil are found large portions detached from the living rock.

In considering the whole subject of the deluge, including not only its physical appearances, unfolded by geological research, but its moral cause, as declared by the inspired volume, we cannot too much admire the Divine wisdom and goodness which has caused such a tremendous judgment to end in an arrangement so beneficial. The beautiful scenery of the earth, with its valleys and hills, covered with a green carpet of grass, and adorned with flowers, or waving with lofty forests, or gracefully interspersed with the smooth expanse of lakes, reflecting surrounding nature on their peaceful bosom, or with streams rolling their ever-flowing tide to the

* Geology of Scripture, p. 345.

ocean; while the distant horizon melts away into blue mountains, whose tops reach the clouds,—all this is the result of that dreadful convulsion which offended justice inflicted as a deserved punishment on accumulated and increasing guilt; but which a paternal hand controlled, and an all-wise Providence converted to purposes of mercy and of love.

There is something unspeakably gracious in the promise made to Noah, when he and his family issued from the ark, and set their foot for the first time on a submerged, but renovated world. "I do set my bow in the cloud, and it shall be for a token of a covenant between Me and the earth. And it shall come to pass, when I bring a cloud over the earth, that the bow shall be seen in the cloud; and I will remember my covenant which is between Me and you, and every living creature of all flesh; and the waters shall no more become a flood to destroy all flesh."—"While the earth remaineth, seed time and harvest, and cold and heat, and summer and winter, and day and night shall not cease."

With what a fine vein of poetic feeling has our most celebrated living poet alluded to this sublime and paternal declaration, in his address to the Rainbow:—

"When o'er the green undeluged earth,
Heaven's covenant thou didst shine,
How came the world's grey fathers forth
To watch thy sacred sign!

"And, when its yellow lustre smiled
O'er mountains yet untrod,
Each mother held aloft her child,
To bless the bow of God.

"How glorious is thy girdle cast
O'er mountain, tower, and town,
Or mirror'd in the ocean vast,
A thousand fathoms down.

"As fresh, in yon horizon dark,
As young thy beauties seem,
As when the eagle from the ark
First sported in thy beam.

"For, faithful to its sacred page,
Heaven still rebuilds thy span,
Nor lets the type grow pale with age,
That first spoke peace to man!"

CAMPBELL.

FOURTEENTH WEEK—SUNDAY.

WINTER NOT MONOTONOUS.—BOUNDLESS VARIETY OF NATURE.

The winter landscape has been accused of monotony; and certainly all Nature has at this season a less animated and varied aspect than at any other. Unless when sprinkled over with hoar-frost, or covered with a cold mantle of snow, the surface of the earth is of a bleak and faded hue. The woods have long lost the variegated foliage, that had previously ceased to be their ornament; and the branches of the trees, with their "naked shoots, barren as lances," present one uniform appearance of death and decay. The howling of the long-continued storm, and the few faint bird-notes heard at intervals in the thickets or hedges, are monotonously mournful. The devastation of the earth, and the sounds that seem to bewail it, are general and unvaried. A few hardy plants and flowers, indeed, begin to swell their buds and expand their petals; but the thick cerements which envelope the one class, and the pale and sombre hue of the other, equally proclaim to the querulous mind the ungenial climate.

Such, at a cursory glance, appear to be the aspect and tone of our winter scenery. But the keenly observant eye discovers, even at this desolate season, and in the midst of seeming monotony, that endless variety which characterizes every province of creation. On close inspection, indeed, all we behold is varied. Whatever be the season, and wherever lie the scene of our observation, though many things are apparently similar, yet none are exactly or really so. At certain times and places, the mutual resemblances between all the common objects of sense, all that solicits the eye or the ear in the landscape, may be so numerous and striking, that a feeling of monotony ensues; groups of mournful sights and

sounds may, in the dead of the year, successively impress us with a sense of melancholy, and incline us to set a limit to the usual prodigality of nature; but yet true wisdom, aided by quick and active observation, easily draws the dull veil of uniformity aside, and reveals to the admiring eye boundless diversity even in the ravaged and gloomy scenery of winter.

Are the woods so uniformly dead, as, on a first survey, they appear? The oak, the ash, the beech, and most of our forest trees, have lost their varied foliage; but, with the exception of the larch, the numerous varieties of the fir and the pine, retain their leaves, and variegate the disrobed grove with their unfading verdure. In the woodland copse, or lonely dell, the beautiful holly still gladdens the eye with its shining and dark-green leaves. Nor are our shrubberies without their living green. The laurel and the bay defy the blasts of winter, and continue to shelter and beautify our dwellings. The flowers have not all vanished. One of the fairest, and seemingly one of the most delicate of them all, the Christmas rose, spots the garden or shrubbery with its bloom, unhurt by the chilling influences of the season. Before the severity of winter is over, the snow-drop emerges from the reviving turf, the lovely and venturous herald of a coming host. Thus, in the period of frost, and snow, and vegetable death, the beauty of flowers is not unknown; but rather what survives or braves the desolating storm, is doubly enhanced to our eyes by the surrounding dreariness and decay.

And are the atmospherical phenomena of this season monotonous or uninteresting? Independently of the striking contrast they present to those of summer and autumn, they are of themselves grandly diversified. The dark and rainy storm careers over the face of the earth, till the flooded rivers overflow their banks, and the forest roars like a tempestuous sea. The hoar-frost spangles the ground with a white and brilliant incrustation, or the snow, falling softly, covers the wide expanse of moun-

tain, and wood, and plain, with a mantle of dazzling purity. Then the dark branches of the trees, bending under a load of white and feathery flakes, have a picturesque aspect, and seem to rejoice in the substitute for their lost foliage. And how fantastically beautiful are the effects of frost. Water is transmuted into solid forms, of a thousand different shapes. The lake, and even the river itself, becomes a crystal floor, and the drops of the house-eaves collect into rows of icicles of varying dimensions, differently reflecting and refracting the rays of the mid-day sun. The earth is bound in magical fetters, and rings beneath the tread. The air is pure and keen, yet not insufferably cold. Calm and clear frosty days, succeeded by nights that unveil the full glory of the starry firmament, are intermingled with magnificent tempests, that sweep over the land and sea, and make the grandest music to the ear that is attuned to the harmonies of nature.

Variety seems to be a universal attribute of creation. It is stamped upon the heavens, the earth, and the sea. The stars are all glorious; but "one star differeth from another star in glory." The sun eclipses them all; and the moon reigns among them like their queen. The earth is covered with numberless mountains and hills, thick as waves on the ocean, and more wonderfully diversified. From the tiny hillock to the cloud-piercing peak, no two eminences are wholly alike in shape, or size, or in any single quality. What valley or plain, what tree, or flower, or leaf, or blade of grass, is, in all points, similar to another? Search the whole world, and you will find no pair of any of these created things exact counterparts to each other, in regard to weight, colour, structure, figure, or any other essential or accidental property. The animal world is as endlessly diversified. Not only is the distinction between the various genera and species wide and impassable, but between the individuals of each species, no perfect similarity exists. Twins are commonly most like each other;

but yet we are at no loss to distinguish between them. Even when we take two parts, however apparently alike, of two individuals of the same species, we find the same diversity. The variety observable in the human countenance, has long been a matter of remark and admiration. The general features are the same in all; but their colour, their relative size, and numerous other particularities, are curiously different. Hence we can at once recognize an individual among a thousand, even when they are of the same stature and complexion with himself.

The diversity of colour is truly astonishing, and is the source of much beauty and enjoyment. Though the primary colours are only seven, yet these are so mixed and blended over all nature, as to delight the eye with thousands of different hues, of all degrees of depth and brilliancy. Let us look at a bed of blowing summer flowers, and behold the ravishing wonders of colour. The unstained silvery whiteness of the lily, the deep crimson of the rose, the dark and velvety blue of the violet, the bright yellow of the wallflower and the marigold, are but specimens of the rich and gorgeous hues that delight us with a sense of beauty and variety. The fields and lawns, with their bright green, spotted with white clover and crimson-tipped daisies; the meadows, with their butter-cups, and all their peculiar flowers; the woods, with their fresh spring verdure, and their flaming autumnal robes; and the mountains, at one time bathed in a deep azure, at another shining with golden sunlight, all exhibit the marvellously varied touches of that pencil which none but an Omnipotent can wield.

This universal variety is not merely a display of Infinite Skill, but is equally beautiful, pleasing, and useful. It adds immensely to our enjoyment of nature, and greatly enhances our idea of God's creative attributes. It furnishes us with the means of discrimination, without which the earth would be to us a scene of confusion. Were there only one colour, and were every mountain,

for example, of the same shape, or every shrub and tree of the same size, how dull and monotonous would be every landscape! And, if every human face were exactly alike, how should we be able to distinguish a friend from an enemy, a neighbour from a stranger, a countryman from a foreigner? Or, to take an example still more impressive, were the powers and passions of every individual mind in every respect similar, that diversity of character and pursuit which constitutes the main-spring of society and civilization, would not be found. In all this, there is adaptation and wise design.

Thus, amidst apparent uniformity, the necessary variety every where obtains. Nor does this variety ever run to excess. Utter dissimilarity is as rare as complete resemblance. All things are beautifully and usefully varied; but they also all wear the distinguishing mark of the same Great Artist, and can all be arranged into classes, the individuals of which bear to one another the most curious and intimate resemblances. There is in nature a uniformity that is as beneficial as variety itself. The leaves, flowers, and fruits of a tree or shrub, though infinitely varied in their figure and appearance, are yet all so much alike, that they can easily be referred to their parent species. All the animals of a kind have each their peculiarities; but every individual can at once be recognized by the naturalist's practised eye. Thus has the Author of all things so blended variety and uniformity together, as to delight, yet not bewilder us, with exhaustless novelty; to enable us to class his works into great groups of genera and species, and thereby to exercise our powers of reason and observation, in tracing the delicate resemblances and disagreements that meet us in all our inquiries. In the classification of these resemblances and disagreements philosophy is mainly employed; and but for them, the active and inquiring mind of man would find no motive for the exertion of its loftier powers. We live and move in a world of inanimate substances, infinitely diversified in form, colour,

and chemical properties, and intermingled with organic structures that ascend from the extreme of simplicity to all that is wonderful and complex in contrivance, and that possess almost every conceivable diversity in their essential qualities as well as their modes of existence; and to bring order out of this seeming confusion,—to observe, to generalize, and to classify,—to note the limitless variety of created things, and yet to discover the Divine harmony that pervades them all, is the noble province of the philosopher, and even of the humblest lover of Nature, who would enjoy aright the objects of his love, and adore with due intelligence the great Author and End of all.

O Lord! every quality of thy works is the result of Infinite Wisdom. The grand diversities of the seasons, with all their distinguishing characteristics, the beautiful harmony, and unlimited variety of nature, alike evince Thy goodness, and demand the cheerful gratitude of man. J. D.

END OF "WINTER."

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